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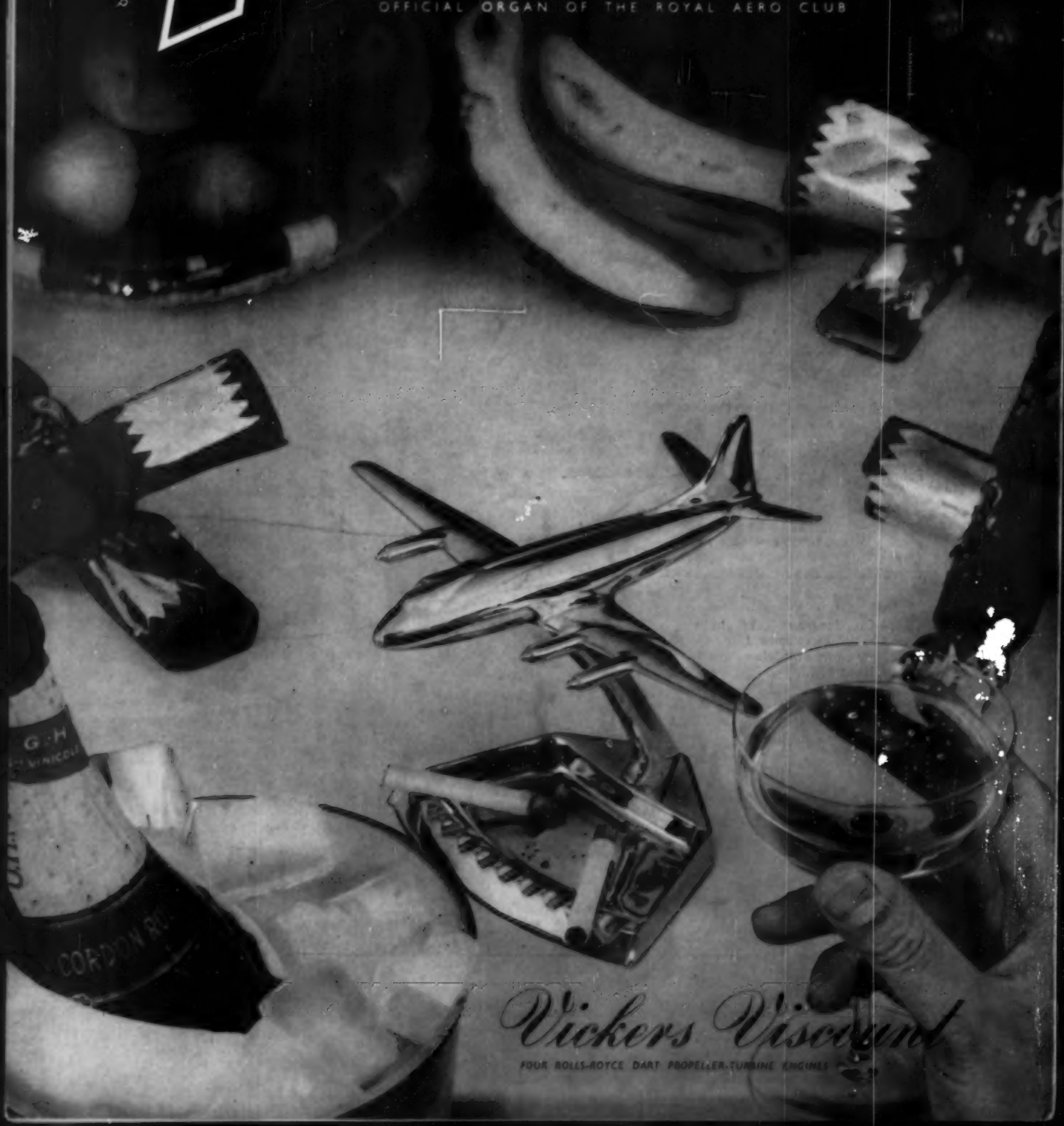

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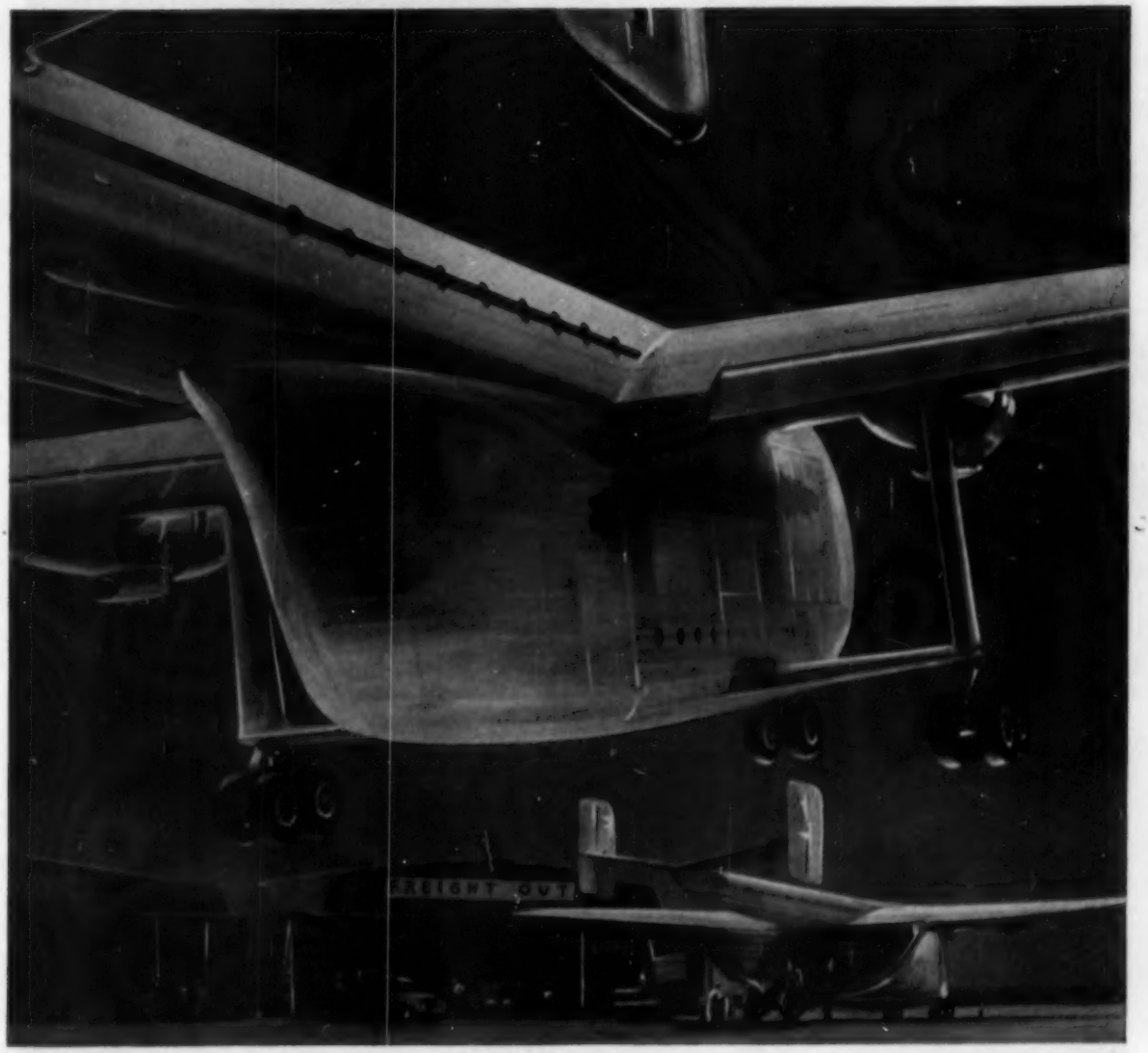

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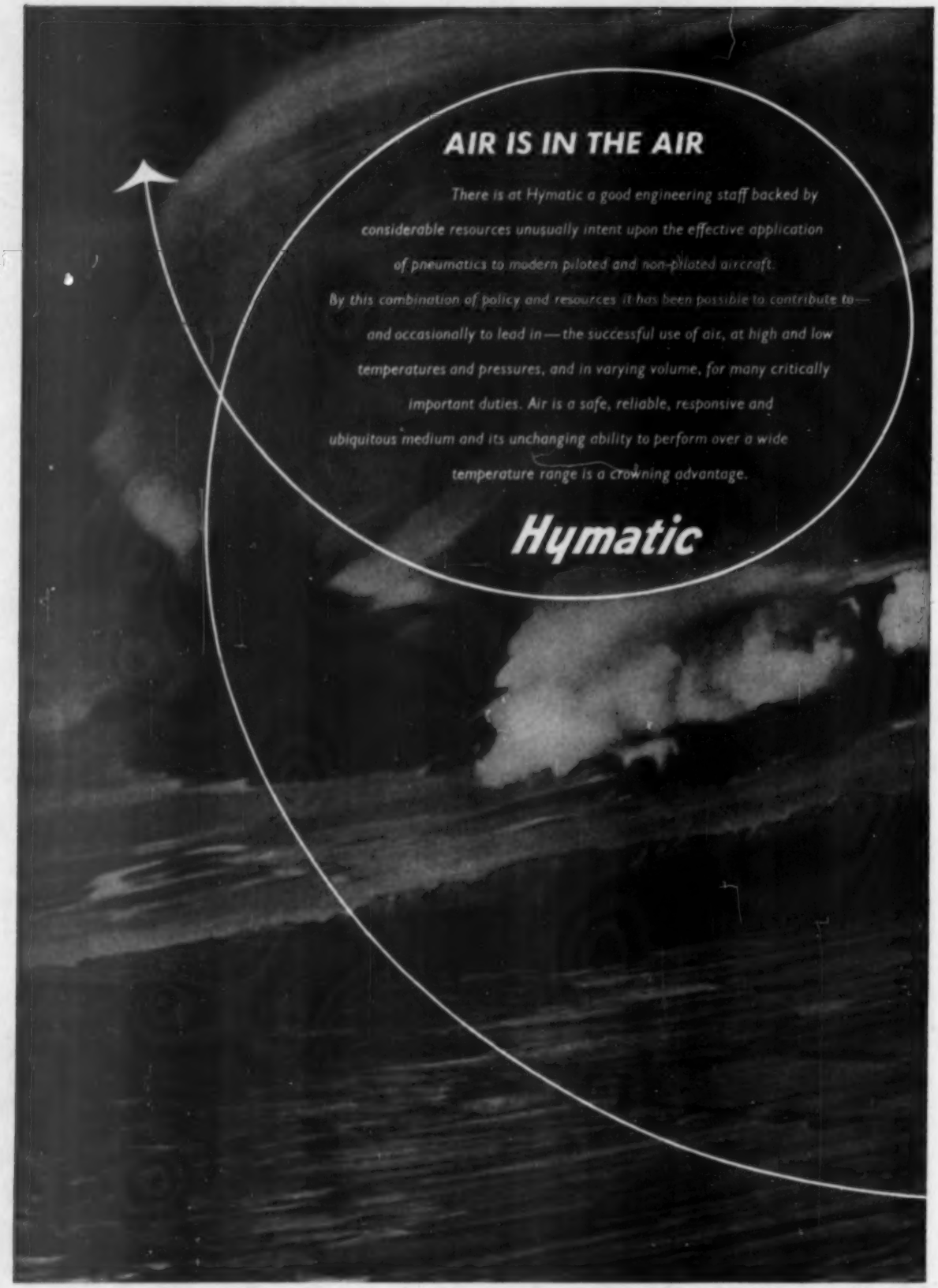
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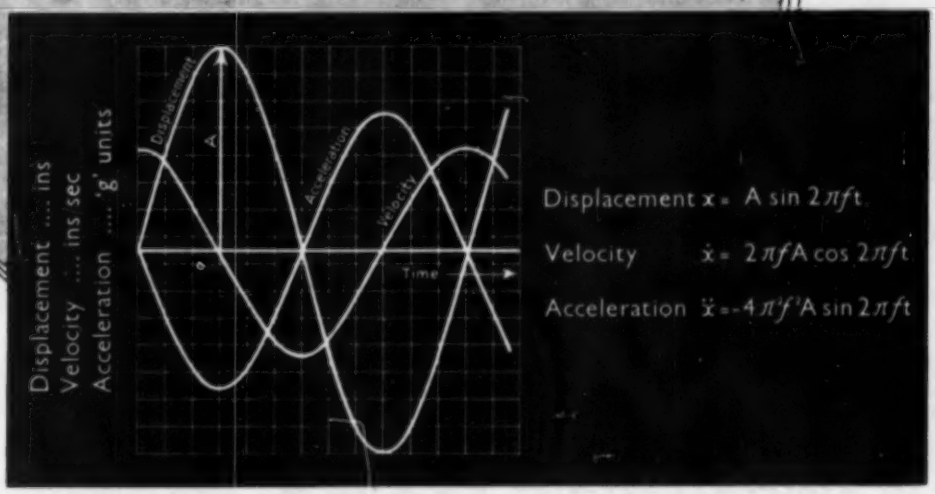

When a particle is experiencing a sine wave vibration it is said to be executing Simple Harmonic Motion (S.H.M.) This applies to objects attached to a vibration generator for vibration tests. Just like the pendulum of a clock, the object moves from the neutral position to its maximum amplitude 'A' where it stops and then starts moving in the other direction. As it passes through the neutral position it reaches its maximum velocity and then slows down until it again stops at the other point of maximum displacement. At these two points *the velocity is instantaneously zero but the rate of change of velocity, (acceleration) is a maximum.*

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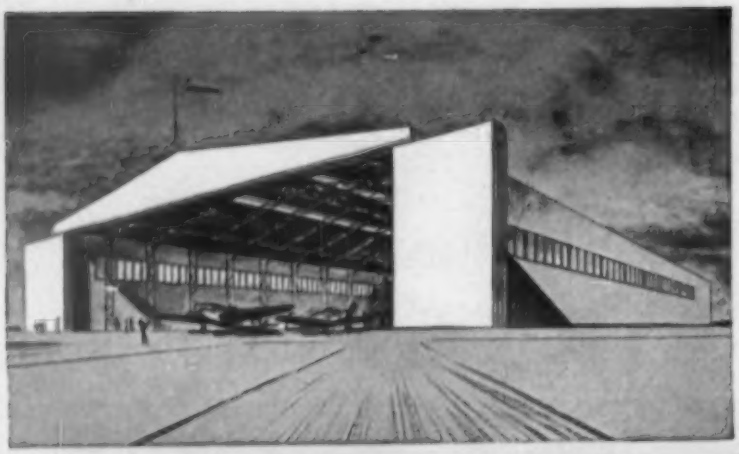

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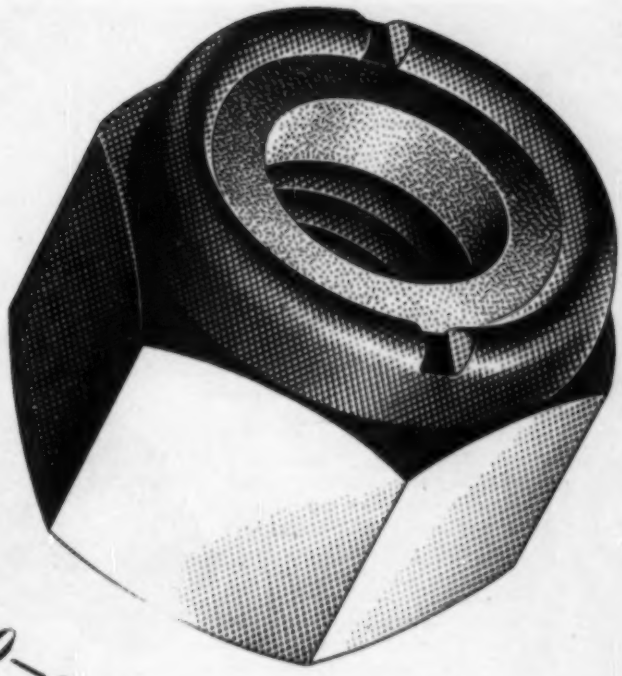

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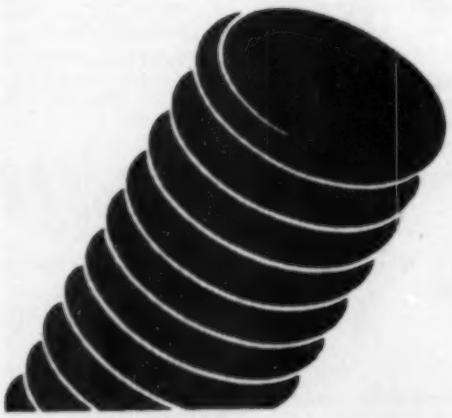

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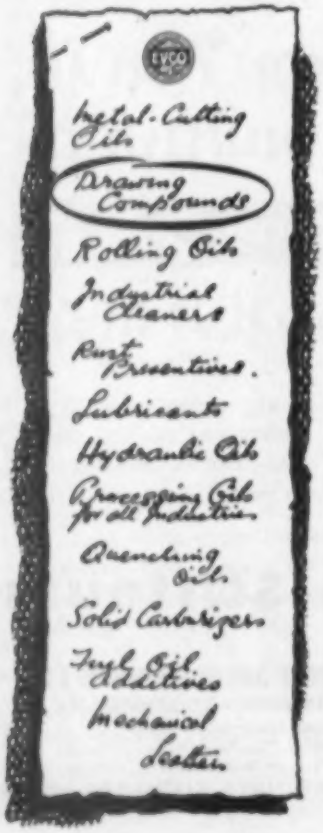

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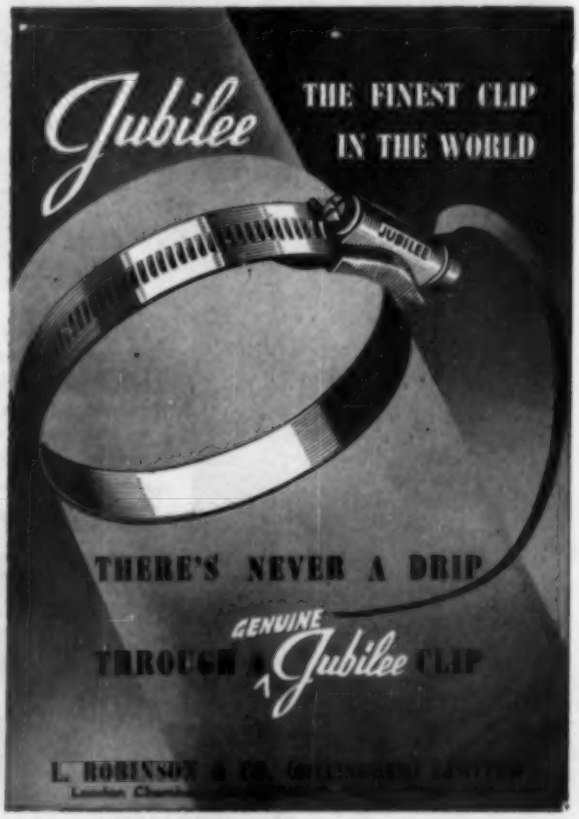

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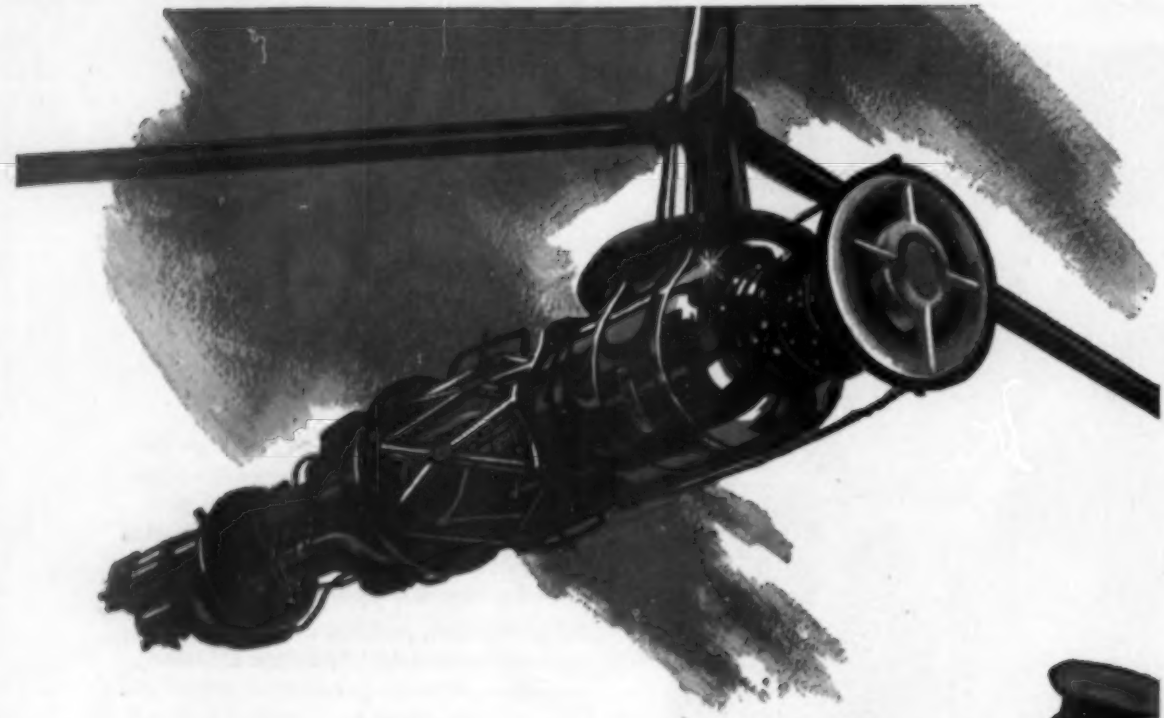

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FIRST AERONAUTICAL WEEKLY IN THE WORLD FOUNDED 1909

FLIGHT
and
AIRCRAFT ENGINEER

No 2448 Vol 68 FRIDAY 23 DECEMBER 1955

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Sustained Supersonics

FASTER-than-sound flight is still a rarity. Almost nine years after it was first achieved by a manned aircraft it is still familiar only to a select band of test pilots and fighter pilots—and then only for periods of brief duration. Nevertheless, attention is being increasingly focused upon aircraft which will be able to cruise at supersonic speed for thousands of miles; in fact, there are indications that some of the most important civil and military long-distance aircraft now on the drawing boards will be able to maintain Mach 1.5 or 2.0 (or perhaps more) for upwards of two hours. Such Mach numbers are not new: research aircraft and at least one fighter have many times reached speeds approximately twice that of sound. Yet the problems involved in the design of a large aircraft capable of doing a worth-while job at such a cruising speed are immense.

At present there are no large, long-range aircraft capable of cruising at much above Mach 0.9. Any higher speed brings a drastic reduction in efficiency and range, but at Mach numbers greater than about 1.25 the overall range (for a fuel weight equal to a fixed percentage of the maximum weight) begins to rise to a maximum at about Mach 2.7—not far short of the best subsonic figure. This is partially due to the fact that the much increased overall engine pressure ratio (as a result of ram effect) steadily improves the specific fuel consumption, thus helping to balance the unfavourable trend of the lift/drag ratio. Sustained supersonic flight, therefore, can be a perfectly practicable proposition.

Without doubt the most far-advanced of these sustained-supersonic machines is the Convair XB-58 bomber, scheduled to emerge from Fort Worth next year. The B-58 programme could, of course, give Convair a head-start with a Mach 2 transport, but so far the only talk of such aircraft has emanated from our own shores. Sir Arnold Hall has discussed possibilities, and his recent appointment to the Hawker Siddeley Group may lie behind Avro's rumoured work in this field. Handley Page are also watching the supersonic-transport field closely.

Assuredly, we in Britain have some promising powerplants for this rôle, and our work on the jet flap and the v.t.o. "lift jet" are very relevant advantages.

Air Refuelling

IT is recorded in this issue (which marks the 21st anniversary of Flight Refuelling, Ltd.) that the first experiments whereby fuel was transferred in flight occurred in America. In 1923, by means of this then-perilous procedure, a D.H.4B of the United States Army Air Corps stayed aloft for 37¼ hr, and by 1930 a Curtiss Robin had remained on the wing for 647½ hr at a stretch. But the air-refuelling prophets went unhonoured in their own land.

Meanwhile, on his epic flights across the British Empire, Sir Alan Cobham had been spending many a sleepless night (as he lately confessed to us) pondering how he would get his heavily laden machine off the ground next morning.

So it came about that this great and zealous man—greatest of all Britain's long-distance airmen—seized on the same notion as the Americans and forthwith got to grips with the implicit problems and perils.

The present situation is a curious one, for whereas the U.S. Navy and the Tactical Air Force of the U.S.A.F. are firmly committed to the British technique, and associate companies of Flight Refuelling, Ltd., are flourishing in the New World, our own Services are only now giving practical recognition.

Next year, Sir Alan assures us, we shall see not only accelerated trials by the R.A.F. but by the Fleet Air Arm also. He forecasts, too, a "commercial adaptation"—which may reasonably be supposed to involve the Comet.

ABUNDANT as the greetings reaching these offices in past days are our wishes to all "Flight" readers for A HAPPY CHRISTMAS AND A BRIGHT NEW YEAR

IN THE RUNNING: The Bristol B.E.25 turboprop on test (see news item on this page). The airscrew blades are strain-gauged; the slip-ring pick-up can be seen mounted on the nose of the hub.

FROM ALL QUARTERS

More Viscounts for America

SPLENDID news came from Weybridge on December 14th in the form of a Vickers-Armstrongs announcement that a second United States trunk line, Continental Air Lines, Inc., had signed an order for Viscounts. Valued at nearly £6.5m, the order is for 12 Viscount 810Ds, bringing the number of Viscounts sold to 254.

The Viscount 810D will be of similar appearance and dimensions to the V.800 "Viscount-Major" originally developed for B.E.A. Its structure, however, has been designed for higher speeds at all altitudes and for a greater gross weight (some 1,000 lb of additional structure will be provided, but without detriment to the economics of the aircraft).

Delivery of Continental's Viscounts is due to begin in March 1958 and to be completed by September of that year. Their introduction to service is scheduled for July 1958. As delivered, they will be powered by the R.Da.7/1 version of the Rolls-Royce Dart turboprop, providing 1,325 e.h.p. at 20,000ft and giving a cruising speed of 363 m.p.h. Installation of R.Da.8s, producing 1,710 e.h.p. under the same cruising conditions, will raise the normal recommended speed to 400 m.p.h. Viscounts powered with the R.Da.8, which will be available in 1959, will be designated V.840. It is the intention of Continental to convert from 810s to 840s.

An outstanding feature of the Viscount 810/840 will be its take-off and climb performance from hot, high-altitude airfields, as exemplified by the Rocky Mountain area fields which form part of Continental's Western network. Viscounts are at present the only C.A.A.-certificated aircraft with climb and obstacle performance requirements based on "100 per cent temperature accountability," instead of the normal 50 per cent.

Nevertheless, the V.810 will be able to exceed these requirements economically; its R.Da.7 engines—basically capable of giving more than 2,100 e.h.p. for take-off, but de-rated to 1,800 s.h.p. plus jet thrust—will have a reserve of power enabling take-off performance to be maintained at such places as Denver, which is more than 5,000ft above sea level and has temperatures up to 90 deg F. The V.840's Dart R.Da.8, capable of producing 2,500 e.h.p., will be similarly de-rated, virtually eliminating the need for water methanol to restore take-off performance. Proposed initial take-off weights for the two versions of the Viscount are 67,500 lb for the V.810D and 69,000 lb for its more powerful successor.

The interior layout specified by Continental Air Lines will accommodate 52 passengers in 13 rows of four-abreast seats. Windowless toilets will be installed in the plane of the airscrew blades, effectively separating the cabin into two compartments and making for an unusually quiet interior. Other features of the Continental aircraft will be a two-man flight deck, storm-warning radar, pressure refuelling, built-in folding stairs and fuel jettisoning.

Internal fuel will be sufficient for a 1,000-mile sector distance with 13,500 lb payload and a two-hour reserve. Provision will be made for the fitting of slipper tanks, increasing range by 200 miles. Vickers confidently expect that these payload-range characteristics, coupled with the higher speed of the new Viscount, will result in even lower seat-mile costs than those of present versions.

The Continental order brings the number of Viscounts ordered by North American operators to 103. Including spares, these aircraft have an approximate total value of $110m (£39m).

B.E.25 on Test

AS briefly recorded last week, the Bristol B.E.25 turboprop is now running as a complete unit on a test bed at Bristol. Moreover, it is running as a fully equipped and cowled powerplant.

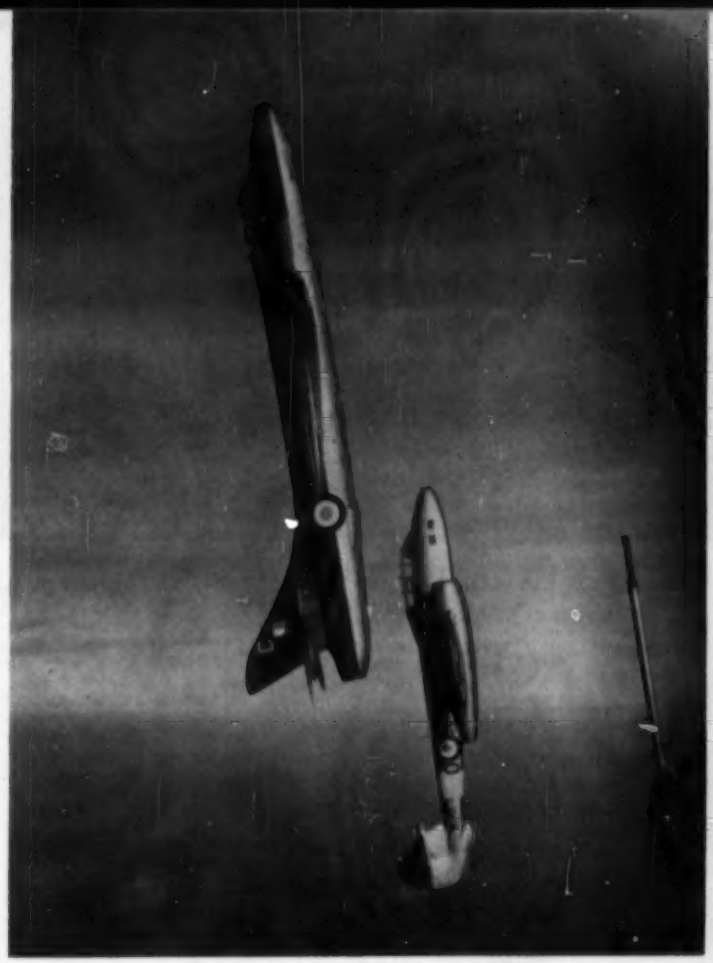
The accompanying photograph shows one of the prototype B.E.25 powerplants engaged in preliminary running at Patchway, with a de Havilland four-blade airscrew. Great care has been taken to achieve the best possible disposition of accessories and ease of servicing.

In our issue of September 2nd last we gave the fullest details of this new engine, and no new data are yet publishable. Principal figures are a maximum design power of 4,050 s.h.p. plus 2,730 lb thrust (low-pressure compressor at 10,500 r.p.m.) giving a total equivalent s.h.p. of no less than 5,050. Even this power is considerably less than could be obtained were the engine not designed as a "constant-power" unit, i.e., the fuel supply is progressively throttled (with the power lever at "full power") as the engine descends from about 20,000ft to sea level. Conversely, the power available at sea level can be maintained, undiminished, right up to about 20,000ft, so removing all limitations of airfield height or temperature and providing considerable cruising power.

Typical cruising power will be 3,080 e.h.p. at 36,000ft and 350 kt, coupled with the remarkable s.f.c. of 0.385 lb/hr/e.h.p.

B.O.A.C. have ordered 60 of the new engines, and it is intended that these shall be installed, as retroactive modifications, in the Corporation's Britannia 300 LRs. In these aircraft the new engine will permit a marked increase in weight-payload and range, and will also increase the cruising speed up to the Mach 0.75 limit of the airframe. Later on the B.E.25 will power the Bristol/Convair/Canadair 120-seat, 500 m.p.h. transport which will be able to tackle the Atlantic under all conditions of weather and load. It is envisaged, say Bristol, that this aircraft and its engine will be built concurrently on both sides of the Atlantic.

DOLLARS FROM DENVER: Seen with Mr. George Edwards (right) in the latter's Weybridge office is Mr. Robert F. Six, president of Continental Air Lines, whose £6.5m order for twelve 360/400-m.p.h. Viscounts is reported above. Based at Denver, Colorado, Continental serve 50 communities in six Western states—Colorado, New Mexico, Kansas, Missouri, Oklahoma and Texas. At right is an impression of the V.810D as it will appear in Continental's colours.



C.F.S. INSTRUCTORS are as good today as they ever were. Here two of them—F/L. D. Hall in a Hunter, and F/L. D. Franklin in a Meteor 7—are getting in a spot of aerobatic time. The picture was taken by Russell Adams from a second Meteor, flown by F/L. H. Harrison.

New European Air Defence System

THAT the Soviet threat was "greater than at any previous time" was the view expressed by Gen. Gruenther, the Supreme Allied Commander, in a statement made in Paris last week. The NATO Chiefs of Staff, he said, were of the opinion that Russian bombers could reach any part of the Atlantic Pact area.

The general was announcing the creation of a co-ordinated air defence and radar warning system, under SHAPE, for the whole of Western Europe including Britain. In the past, he explained, SHAPE's control of air defence had been confined to Western Germany, and in other NATO countries had been a national responsibility.

This system did not provide adequate insurance, so four new defence sectors were being established: (1) Norway and Denmark, with H.Q. at Oslo; (2) the Low Countries, Germany and France, with H.Q. at Fontainebleau; (3) Italy, Turkey, Greece, and the Mediterranean, including Cyprus, with H.Q. at Naples; and (4) the United Kingdom. The first three were all existing NATO commands, whereas the United Kingdom was a national command, and the R.A.F. would decide on the deployment of aircraft or missiles to repel an attack.

Gen. Gruenther said early warnings were useless unless there was a rapid and efficient communications system. The United States had agreed to share with NATO two radiocommunication systems which provided perfect reception and could not be jammed. One was a tropospheric "scatter" method which could transmit up to 250 miles. The other was a iononspheric system, which had a range of 1,300 miles.

The staff needed to run them in Europe would not be more than 250 people. The total cost for Europe would be £15m. The United States would be installing pilot plants to cover Norway, from Paris to Naples and from Naples to Izmir in Turkey.

Rolls-Royce Strike Settled

THE strike of some 7,500 employees at the Rolls-Royce aero engine factories in the Glasgow area ended last Thursday, when the men returned to work after seven weeks. On the previous day, two meetings of the strikers had accepted almost unanimously a recommendation by the executive council of the A.E.U. that there should be a return to work.

Throughout the strike Rolls-Royce have held firmly to their refusal to dismiss or take any other action against the employee over whom the dispute arose. He was a polisher who was expelled from his union because, it was alleged, he had failed to observe a shop agreement to limit his bonus earnings at a period when work was scarce.

It is believed that the ultimate effects of the stoppage on production may not be as serious as was at first feared. The engines principally concerned were Avons—of which, it is understood, there was a reasonably large reserve stock, so that it may be possible to regain lost ground by means of increased production. Also, the recent dispute in the Hawker factories is believed to have reduced to some extent the requirement for Avon engines.

Capt. A. G. Lamplugh

IT is with deep regret that we learn as we go to press of the death, on December 15th, of Capt. A. G. Lamplugh, C.B.E., F.R.Ae.S., M.I.Ae.S., F.R.G.S., underwriter and principal surveyor of the British Aviation Insurance Co., Ltd., until his election to its Board last September, when illness compelled his retirement. He was 60 years of age.

Capt. Lamplugh.

Alfred Gilmer Lamplugh was educated at King Edward's School and Queen's College, Birmingham, and learned to fly in 1913. He served in the R.F.C. and R.A.F. in 1916-19, and was the holder of an early "B" Licence, No. 155. He was with the British Aviation Insurance Group before its incorporation as a company in 1931 and had been underwriter to the Group since 1926.

During his career he held a variety of distinguished posts, almost all of them honorary, in bodies concerned with aviation or insurance. He was a Royal Aero Club committee-member; a council-member of the Air Registration Board; Warden, and first Deputy Master, of the Guild of Air Pilots; an honorary member of the British Air Line Pilots' Association; president of the London Gliding Club; and chairman of the Aviation Insurance Offices Association. In 1943 he was chairman of the Independent Committee on the Future of Civil Aviation.

It is a sad coincidence that, the day after his death, it was learned that for his services to aviation in Belgium he had been appointed an *Officier de l'Ordre de Leopold II*.

From the early nineteen-twenties, "Lamps" was a familiar figure at aviation events in every part of the country. Few men can have known so many pilots, amateur and professional, and not merely as casual acquaintances; and they in their turn looked upon him as a good companion and staunch friend—and, in business, a man of the greatest integrity. Almost up to the last, though confined to a wheelchair, he was to be seen enjoying the company of his friends at many a gathering. British aviation will be the poorer for his passing.

Capt. Lamplugh leaves a widow and two sons. The funeral took place privately on Tuesday last. There will be a memorial service at Christ Church, Down Street, London, W.1, on December 29th.

The Guild Losing its Clerk

WHEN, in the near future, the Guild of Air Pilots and Air Navigators is granted its new status as one of the Livery companies of the City of London, changes in its administration will be necessary. In this connection it was announced last week that Mr. L. A. Wingfield, M.C., D.F.C., who has acted as Clerk to the Guild since its foundation, is to relinquish his appointment at the end of the year, as he finds that the claims of his profession preclude his accepting the additional work that will be involved.

During the period of 27 years for which he has held the appointment, Mr. Wingfield has served under three Royal Grand Masters—the Duke of Kent, Princess Elizabeth and the Duke of Edinburgh—and many distinguished Masters including A.V-M. Sir Sefton Brancker and A. Cdre. Frederick Guest.

"Mr. Wingfield has been largely responsible for initiating and carrying through to its successful conclusion the Guild's petition for Livery," says the Guild, adding that it "desires to place on record its grateful thanks to him for faithful and distinguished services given for so long in an honorary capacity."

A Venom N.F.3 returns from a night sortie.

NIGHT'S BLACK AGENTS

"While night's black agents to their prey do rouse."—MACBETH

The Work of the Venom N.F.3s of 23 and 141 Squadrons at Coltishall

"ONLY birds and fools fly," goes the saying, "and birds don't fly at night." Epigrammatic, but inaccurate, since many birds of prey are specially equipped to kill in the dark, which they do with uncanny efficiency and in any kind of weather. Rising as the sun goes down they may be heard about their predatory business at any hour of the night; and at this time of the year, when darkness falls early and the night is long, their activity is at its highest.

But with the dawn they are grounded and helpless, and then no further analogy may be drawn between them and their man-made counterparts, the all-weather fighters, which are as competent in daylight as they are in darkness. Such aircraft as the de Havilland Venom N.F.3, which now equip all-weather squadrons of the Royal Air Force, make sense of the oft-heard phrase "24-hour preparedness"; and, backed by a ground radar system which is probably the most effective in the world, they carry full responsibility for seeking, intercepting and destroying an enemy in the thickest weather and on the blackest of nights.

The Venom N.F.3 was issued to the R.A.F. in the summer, and was first exercised in "Beware" (reported in *Flight* for September 30th and October 7th). It superseded the Venom 2, being a considerably more effective development of that formidable fighter, particularly as to its advanced type of interception radar. Performance is secret, but it may be said that in one respect at least—the ability to climb very quickly to a great height—it probably outstrips any all-weather fighter in service. And its agility and speed at altitude are factors to be reckoned with, as many a "hostile" Canberra crew has discovered.

The first R.A.F. squadron to re-equip with Venom 3s was No. 141 (W/C. P. L. Chilton, D.S.O., D.F.C.), which shares with another illustrious night-fighter squadron, No. 23 (W/C. A. N. Davies, D.S.O., D.F.C.) the East Coast station at Coltishall, Norfolk, now commanded by G/C. J. C. Sisson, C.B.E., D.F.C. A fortnight ago *Flight* was privileged to visit the station to see both squadrons at work. Our host was the wing commander flying, W/C. M. H. Constable Maxwell, D.S.O., D.F.C., under whom the two squadrons operate in close and keenly competitive partnership. The senior technical and administrative officers of the station are respectively W/C. G. V. Meredith, M.B.E., and W/C. R. G. Prior, D.F.C.

Before describing, within the bounds of very rigid security, the activities of the two squadrons, it is appropriate to consider night and all-weather flying in its broader aspects, as an art, a science, and a challenge.

Fuelled, armed and ready—an aircraft of 141 Squadron.

Night flying, which includes by implication all-weather flying, has always been one of those jobs that most fighter pilots prefer to leave to the other man. The reasons are not hard to seek. Pilots of a day fighter squadron feel that they are experiencing flying at its best: they like the comradeship of hunting as a team, the fun of formation flying and aerobatics, the excitement of low flying (in approved areas), and ground attack. The thought of operating in darkness as a regular job, of exchanging art for electronics, does not appeal very much; and pilots, who are no less diurnal by habit than other human beings, have an instinctive respect for "unnatural night." Not for them, the day fighter pilots say, a flying job which, because they have not experienced it, they imagine as dull and shackled to science—in short, to use the jargon of the day, deadbeat.

It is no national secret that the country's night fighter force, having during the war reached the highest summit of efficiency, subsequently declined. It is only in the last few years that it has been built up to the potent state in which we see it today, and it is still expanding, as anyone who has seen the Javelin production lines might deduce. The demand for crews is insatiable, and pilots are drawn not only from the flying training schools (Provost and Vampire T.11) *via* the operational conversion units (Meteor N.F.14), but, after a spell at an O.C.U., from the day fighter squadrons as well. One can thus imagine the feelings of many day pilots when they learn that they are to be posted to a night fighter squadron after a tour back at Training Command. One fate, they affect, surpassed only by the other!

But those who have tasted life with an all-weather squadron discover that it offers a satisfaction found perhaps in no other form of flying. Night operations comprise only a half of a round-the-clock programme that combines the fun and the art of day flying with the science and the challenge of night and all-weather work. One gets, as it were, the bun and the halfpenny as well—all the pleasures of day flying, plus a lot more. Science is enlisted to secure complete independence of weather and to seek out the quarry, but always there is a mind-over-matter exhilaration in—for example—the sudden sighting and killing of an enemy high up in the abyss of the night, only a few minutes after scrambling from the crew-room for a take-off in foul weather and a climb through perhaps 30,000ft of cloud.

The magic of moonlight on the cloud-tops, especially when seen from extreme height, is a source of unfailing delight, and on clear nights the view is astonishing. It is quite easy to see the lights of London from 40,000ft over the Zuyder Zee, and to pick out the myriad tiny lights of shipping in the English Channel. And, on bad nights, landing after a ground-controlled approach—a long, low, bumpy penetration through cloud with nothing to see except the rain-streaks on the windscreen until the lights of the runway threshold suddenly appear—gives a feeling of satisfaction to even the most veteran pilots.

Before we turn from a general commentary on night flying to a detailed account of aircraft and crews at work, one particular point is worth recording. It is that, as a general rule, the best night fighter pilots are those with day fighter experience. To have mastered gunnery and instrument flying is an invaluable background to night fighting, in which the perfection of interception and combat techniques is one of the prime preoccupations. As one experienced pilot put it: "Anyone can fly gently around at night doing nice precision turns, but to be an effective night fighter he's got to be confident enough of his instrument flying to be able to throw the aeroplane around."

"FLIGHT"
photographs

Twilight formation by 23 Squadron, with cumulus threatening dirty weather for the coming night.

The two squadrons at Coltishall devote alternate weeks to day and night flying, and in this way full round-the-clock practice is maintained without undue strain being put upon aircrews and ground crews. The week before last, for instance, 23 Squadron worked the day shift, beginning flying at about 0900 hr and continuing until dusk. A typical day's work might include half-a-dozen sorties on one or more of a variety of missions: cross-countries, air-to-air gunnery with the station's Meteor 8 target tug, formation flying, instrument flying, G.C.A. let-downs, and, of course, ground-vectored interceptions, usually of one Venom by another. In the afternoon, early or late depending upon the time of year, the duty night squadron—on the occasion of our visit, No. 141—flight-tests its Venoms in preparation for the night's work, in accordance with customary night-fighting practice. The night is spent mainly in performing ground-vectored interceptions, with Venoms working as pairs. "Bomex" exercises, in which Canberras usually comprise the attacking force, are frequent. In the night of Thursday, December 8th, for example, a hostile force of more than 70 Canberras, on their way to bomb Weymouth, was intercepted by East Coast night fighter squadrons, including No. 141.

Perhaps the most entertaining vantage point for observing such an exercise is the squadron crew-room. Undoubtedly the best picture of the battle as a whole is obtained at Sector H.Q., where every component of the defence machine, from the coastal radar stations to the aircraft at readiness at each of a number of night fighter airfields, is co-ordinated. But in the crew-room one is closer to the heat of the fray: pilots and navigators hastily abandon a game of clag (more suitable than bridge, because of its shorter rubbers) to scramble, either straight from the apron to take-off, or to the operational-readiness platform at the end of the runway. From here Sector H.Q. can get an aircraft into the air at a moment's notice by means of the "telescramble," even though the engine may have been switched off. A cartridge start, full power without a warm-up, and straight off on a G.C.I. (ground-controlled interception).

The wartime system of interception is in its essentials retained, but with certain significant differences that for security reasons cannot be described in detail. The whole machine has, in effect, been area-ruled in conformity with the contemporary tempo: an example is the "recovery" procedure, by which any number of returning fighters, their gallons going fast, can be sorted out by the airfield control and brought straight on to the glide-path at very short intervals without overloading the G.C.A. Perfection of this procedure has been one of the most noteworthy successes of the R.A.F.'s all-weather operations. In place of the old QGH technique is a slick system in which fighters are brought in from all points of the compass, with allowance automatically made for the prevailing wind.

To return to the crew-room. Here one can listen in to the conversations of returning pilots and navigators, who only a few minutes before, it seemed, had left their card games. Since then they have perhaps made several interceptions eight miles up over the Continent. Experiences are exchanged over the *Esquire*-decorated counter of the coffee-bar. The duty operations officer is heard to announce that both wing commanders have got three, which solicits the inevitable enquiry, "Stripes or Canberras?" and others less respectful. One of the wing commanders returns, confirms that he got two Canberras and an odd B-45 ("that'll teach the U.S.A.F. to tell people when and where they're flying") and asks to see the flight sergeant in charge of the ground crew about a half-minute delay before take-off.

The battle continues, each man a vital component of a vast and intricate mechanism the simple object of which is the annihilation of any enemy who may approach Britain's shores, by day or by night, and in any weather.

J.M.R.

A Venom N.F.3, as it might be seen by the crew of an intercepted Canberra.

The former Station Commander of R.A.F. Coltishall, G/C. P. P. Hanks, D.S.O., D.F.C., A.F.C. (left) with G/C. J. C. Sisson, C.B.E., D.F.C., who took command on December 12th.

HERE AND THERE

OVER CHESAPEAKE BAY, near Baltimore, is this Martin Mariner, modified to incorporate a hydroski to decrease the impacts encountered during rough-water landings and take-offs. The ski was designed and built by the Edo Corporation, and is located slightly forward of the c.g. Tests have been made with the ski in three different extended positions—close to the hull bottom, partially extended and fully extended.

P.1 Record Attempt

ALTHOUGH there is no official confirmation that definite arrangements are being made for an English Electric P.1 to attack the world's speed record next year, as reported in the *Daily Telegraph*, the likelihood of such an attempt is obviously strong. Of the reported Avon power units, all that can be said is that such an installation is feasible.

Sir Miles Thomas Joins A.R.B.

THE Air Registration Board announced last week that Sir Miles Thomas, chairman and chief executive of B.O.A.C., had been appointed a member of the Board. He fills the vacancy caused by the resignation of Mr. Whitney Straight.

Vulcan Base

THE Avro Vulcan is due to go into R.A.F. service in the very near future and the base has been prepared for the first squadron at Waddington, near Lincoln. Handley Page Victors will begin to reach squadrons soon afterwards.

For Australian Airfield Safety

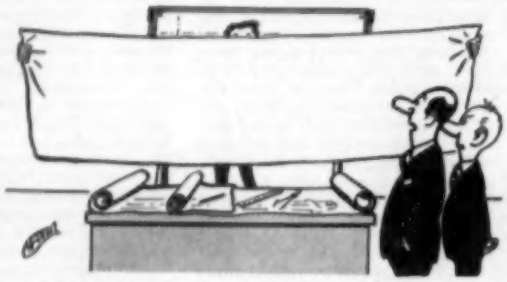
THREE power-driven saws and "a fire-fighting chemical not previously used in Australia" are among the equipment of a new crash tender recently demonstrated in public at Laverton R.A.A.F. Station. Five of these tenders have been ordered by the Australian Civil Aviation Department.

S.A.S. Furlough Flights

NO fewer than ten DC-6-loads of U.S. Servicemen have taken advantage of special leave flights offered by Scandinavian Airlines System between four German cities —Nuremburg, Frankfurt, Stuttgart and Bremen—and New York. Fares for the return trip are in the region of £105-£110. As S.A.S. have no traffic rights for the direct journey, flights were routed *via* Copenhagen, continuing to New York with different flight numbers.

H.P.'s New Herald

HIGHEST-PRICED bull at an annual show and sale of Dairy Shorthorn cattle at Banbury was bought by Sir Frederick Handley Page. It was appropriately named Hindwell Herald.



"There's something strange about the way that chap reads a drawing."

XH-17 Swan Song

THE world's largest single-rotor helicopter, the Hughes XH-17, has completed its final tests by carrying a 7,800-lb trailer van. With this load it was airborne at a height of about 20ft for 5 min. Mr. Hopper, the company's general manager, said that the test opened the way for helicopters which would carry 75 troops with combat equipment, a 155 mm howitzer, a 2½-ton truck, a bulldozer, or even an assembled bridge. The XH-17 is powered by two J-35 turbojets, feeding rotor-tipped burners.

A Dak Goes Topdressing

THE biggest aerial topdressing venture in New Zealand will soon get under way when James Aviation, Ltd., of Hamilton, start to operate an ex-R.N.Z.A.F. Dakota carrying five tons of granulated fertilizer. The machine will be operated from Ardmore Aerodrome, and will work over a radius of 40 to 50 miles. Mr. O. G. James, managing director of the company, said that from Ardmore the machine would spread about 100 tons a day in 20 flights; and, with the use of a loader costing £4,000, five tons of fertilizer would be loaded into the aircraft in two minutes.

Distaff Pilots

SEVERAL women jet pilots are serving in the Czechoslovak Air Force, says Prague Radio, and one of them, Eleonora Bacova, has received a State decoration for outstanding achievements in flying.

Flying Film in Birmingham

A FILM show "open to all who are interested" is being held by the Birmingham and District Aviation Club at the International Centre in Suffolk Street, Birmingham, on Friday next, December 30th, at 7.15 p.m. The principal film will be the American picture *We Saw it Happen*, covering the first 50 years of powered flight from the American angle.

Recce Exhibition

TO publicize President Eisenhower's "Open Skies for Peace" plan, under which the United States and Russia would make photographic flights over each other's territory, the United States Air Force is holding a special display of reconnaissance photographs in New York. Both high- and low-altitude pictures are on view and the main feature of the show is a strip of film 200ft long by 9in wide covering a track 2,700 miles long and several hundred miles wide, from Santa Barbara, Calif., to New York.

MINISTER SITS IN: The Minister of Supply, Mr. Reginald Maudling, in the Avro Aircraft CF-100 during his recent visit to Malton, Ontario. Explaining the cockpit layout is Mr. Harvey Smith, vice-president manufacturing, Avro Aircraft.

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The prototype F.5 of 1918. It was put into production with a number of F.3 features to facilitate manufacture and its performance suffered in consequence.

HISTORIC MILITARY AIRCRAFT No. 11

Part 3

By J. M. BRUCE, M.A.

THE FELIXSTOWE FLYING-BOATS

THIS is the third and concluding instalment of Mr. Bruce's article; parts 1 and 2 were published on December 2nd and 16th respectively. The author expresses his indebtedness to Mr. Bruce Robertson, who has provided the data on serial numbers, and certain other information.

THE last of John Porte's twin-engined flying boats was the F.5. No doubt it was intended to be an improvement upon the F.3; and, indeed, the hull of the prototype F.5 was regarded as being second in quality only to that of the larger Felixstowe Fury. Structurally it was identical with its predecessors, and the hull was of characteristic Porte form, with side fins running along two-thirds of its length. The top decking of the hull was deeper than on any of the earlier Felixstowe boats; and the pilots sat side-by-side in an open cockpit. The usual double-diagonal planking was used, and behind the wings the hull sides were fabric-covered, with a mahogany washboard covering the lower portions.

A new wing structure was designed for the F.5: the span was slightly greater than that of the F.3 and a completely new section was used. The ailerons were of constant chord, projected behind the trailing edge of the mainplane, and had horn balances, whereas those of the F.2A and F.3 had been of the inversely-tapered shape originated on the Curtiss boats. The tail unit looked similar to that of the F.2A and F.3, but the broad-chord tailplane projected some way in front of the leading edge of the fin, and the rudder had a balance area forward of its axis and inset into the fin. The engines were two Rolls-Royce Eagle VIIIs; and the aircraft bore the official serial number N.90.

On test, N.90 performed well. When it underwent its official trials in May 1918 it was tested at four different loaded weights: even in the overload condition (a.u.w. 13,306 lb) its speed was 102 m.p.h. at 2,000ft and its ceiling 9,200ft. The F.3's speed at a comparable weight was only 90 m.p.h. and its service ceiling 6,000ft.

In view of Porte's own misgivings about the F.3 and the obvious superiority of the F.5, it might have been natural for the F.3 to be superseded in production by the later type. Unfortunately, that did not happen. The F.3 was in production on a relatively wide scale, and the Ministry of Munitions was opposed to the introduction of a completely new type with the inevitable need for new drawings, jigs and templates. The F.5 design was therefore extensively modified to incorporate as many F.3 components as possible.

The modification resulted in an aircraft which was not wholly satisfactory. The hull was an attempt to approximate closely to that of N.90 while using as many F.3 parts as possible. It was covered completely with plywood, with the exception of the top decking: this covering, although structurally and operationally desirable, added considerably to the weight of the hull. The basic structure had also been made heavier by the modifications necessitated by the use of F.3 fittings.

The wing structure was that of the F.3, with R.A.F.14 aerofoil section. The wings were modified to facilitate production; adapters were fitted to enable the interplane bracing to be made by either cables or Rafwires; and permanent slinging gear was incorporated. The ailerons, of constant chord and horn-balanced, were similar in appearance to those of N.90; and the tail unit had the broad-chord tailplane and balanced rudder which had appeared on the true F.5. Later F.5s had horn-balanced elevators.

The designation F.5 was retained for the production aircraft, which, thanks to all the modifications, weighed over 1,000 lb more than N.90. Official test figures show that the performance of the production F.5 was somewhat inferior to that of the F.3.

The F.5s came too late to see operational use during the war, but the type was adopted as the R.A.F.'s standard flying-boat in the years immediately following the Armistice. When the war ended, contracts for flying-boats were either cancelled or substantially reduced: many F.5s were put into store, later to be withdrawn and reconditioned for Service use; but the numbers needed by the post-war R.A.F. were few.

Production of the F.5 was undertaken in Canada by Canadian Aeroplanes, Ltd., of Toronto, a Government-sponsored undertaking which had been organized late in 1916 as a source of aircraft supply for the Allies. These F.5s were ordered by the U.S. Air Board, and 30 were delivered in seven months. By the time of the Armistice the Canadian firm were building F.5s at the rate of eight per month. These machines were fitted with Liberty 12 engines in place of the Rolls-Royce Eagles of the standard F.5.

A version of the F.5 was also produced in America under the designation F-5L. There could have been few finer tributes to John Porte's admirable work than the fact that the type of hull construction which he had devised was adopted in the country whence he had obtained the aircraft that had been the starting point of his experiments. The Curtiss company were quick to appreciate the value of the Porte hull, for their H.16 flying-boat had a hull built in accordance with Porte's principles. The H.16 was supplied in some numbers to Britain in 1918.

The F-5L was built by the U.S. Naval Aircraft Factory at Philadelphia, and differed in detail from the British-built F.5. In the hull, the cross-members abaft the wings were made of steel tubing; the longerons were of ash, and the double planking consisted of an inner ply of Port Orford cedar under a skin of Spanish cedar. Liberty engines were, of course, fitted. The armament of the F-5L could consist of a Davis quick-firing gun and as many as eleven Lewis guns; up to 1,000 lb of bombs could be carried; and normal maximum endurance was ten hours. A contemporary American description of the F-5L gave these statistics:—

> "Six thousand distinct pieces of wood go into the making of this machine, and to hold these in place requires 50,000 wood screws and 46,000 nails, braces and tacks. In the hull 600 sq ft of veneer and 4,500 sq ft of cotton fabric are used. The 250 pieces of tubing aggregate 1,000ft in length and to adjust the tension on the 5,000ft of wire and cable, 500 turnbuckles are required; about 1,500 each of bolts, nuts and washers are needed to hold in place the 1,000 metal fittings."

Like the F.5 in Britain, the F-5L arrived too late to be used operationally; but it was adopted by the U.S. Navy as its standard flying-boat and gave years of good service, latterly with a greatly enlarged fin and horn-balanced rudder. It was used by both the Atlantic and Pacific fleets for detection duty.

Before the war ended, John Porte produced another flying-boat at Felixstowe. This was a vast triplane, the largest British aeroplane of its day, powered by five Rolls-Royce Eagle engines. To all at Felixstowe this aircraft was known as the Porte Super Baby, but, having arrived in time to benefit from the official scheme of aircraft nomenclature which was introduced in 1918, it was officially named the Felixstowe Fury.

The Fury was not the first triplane flying-boat to appear at Felixstowe: a large Curtiss triplane had been assembled and flown there some time before. The big Curtiss was originally powered by four 250 h.p. Curtiss engines, but at Felixstowe

Four F.5s: (Downwards on left) production version, showing both the balanced ailerons and the balanced elevators; N.4838, with experimental ailerons; and N.177, the first military flying-boat to have an all-metal hull, which was built by Short Bros; (above) N.178, with experimental hull by Saunders.

THE FELIXSTOWE FLYING-BOATS . . .

these were replaced by Rolls-Royce Eagles. All the engines were installed as tractors on the leading edge of the middle wing. The hull was of typical Curtiss design and construction, with a single step and comparatively short side fins; the wings were all of unequal span; and the tail unit consisted of a fin and three rudders, a tailplane and two elevator surfaces. The elevators did not move in parallel, however, and one must have been used as a trimming surface.

Since nothing was heard of the Curtiss triplane, it is fairly safe to assume that it was a failure. Nevertheless it would be easy to assume that Porte was inspired to attempt the triplane configuration; when he did so, however, he produced an aircraft that was characteristically his own.

The Felixstowe Fury was originally intended to have three Rolls-Royce Condor engines of 600 h.p. each, but the flying-boat was completed before any Condors were available. A new powerplant, consisting of five Rolls-Royce Eagles, was designed: the central engine drove a pusher propeller, and was flanked on each side by a tandem pair of engines. The forward Eagle of each pair drove a two-bladed tractor airscrew; the pushers drove four-bladed propellers. All the engines were mounted on the central mainplane.

The Fury hull was regarded as the best of all the Porte hulls built at Felixstowe. It was 60ft in length from bows to stern-post and had a maximum beam of 12ft 6in. The vee-shaped planing bottom was slightly concave, whereas on all the other F-boats straight-edged sections of 150 deg included angle were used. Structurally, the hull resembled all other Porte hulls, having the usual four longerons braced to form a box girder. The big keelson and the transverse floors were of built-up girder construction; the top rail of each floor was continuous over the top of the keelson. To avoid splitting of the planking at the chine and waist joints (this had been troublesome on the F-boats) the planking of the Fury hull was carefully steamed and bent round the chines and along the fin/hull junction line; this procedure eliminated the joints. The hull planking consisted of two diagonal layers of cedar over an inner skin of longitudinal planking, and the bottom was covered with three layers of cedar and mahogany half an inch thick. Abaft the fins the sides of the hull were fabric-covered.

The top and central mainplanes were of equal span and were fitted with horn-balanced ailerons. The bottom wing was one bay shorter than the others and carried stabilizing floats; it had no dihedral, but the two wings above were rigged at 2 deg.

The original tail unit was of peculiar configuration, reminiscent of the tail of the four-engined Curtiss triplane flying-boat. It was a biplane structure, in which the upper horizontal surface was of greater chord than the lower. The large fin had both its leading and trailing edges raked sharply backwards; above the upper tailplane a small balanced rudder was fitted to the fin, and two outboard rudders were pivoted between the tailplanes.

The tail unit was later moved farther aft and modified. The large central fin was removed, and there were three fins and rudders mounted wholly between the tailplanes.

The Felixstowe Fury must have been one of the earliest aeroplanes (if not actually the first) to be designed to have power-operated controls. In view of the machine's great size it was thought that in certain flight conditions the operation of the flying controls might prove to be beyond the pilot's strength. Servo-motors were therefore fitted to all controls, and longitudinal control was enhanced by using the lower elevator as a trimming surface: it was actuated separately by a long lever attached to a quadrant centred on the main elevator control shaft. When flown, however, the Fury proved to be remarkably light on all controls; in fact, it proved to be better in this respect than the smaller F-boats. The servo-motors were therefore removed, for Cdr. Porte felt that their weight and complication outweighed any advantages conferred by their use.

The designed loaded weight of the Fury was 24,000 lb, but tests showed that that figure could be increased to 28,000 lb without impairing the seaworthiness or take-off characteristics of the aircraft. Even at the greater weight the Fury handled better than any of the F-boats. The load was progressively increased up to 33,000 lb, at which weight Porte himself flew the great machine, taking off from Harwich harbour. The Fury was flown by several of Felixstowe's most experienced boat pilots, including Maj. T. D. Hallam, D.S.C., who took off with 24 passengers, 5,000 lb of sand ballast and fuel for seven hours.

Tests of a model of the Fury hull were conducted in the Froude tank at the National Physical Laboratory, and indicated certain modifications which might be made in order to improve the hull's

hydrodynamic characteristics; some of these changes were made. The boat was flown with one, two and three steps for experimental purposes, but finally had two.

Although provision was made in the Fury for the carrying of armament, the aircraft was never used operationally. The gunner's cockpit which was originally provided in the bows was faired over at about the same time as the modified tail unit was fitted. After the Armistice the big triplane continued to be flown experimentally; and at one time there was a proposal to attempt the transatlantic flight. This project was officially opposed on the grounds of expense, but the crossing would have been well within the Fury's capability; maximum fuel capacity was 1,500 gallons.

The aircraft was wrecked a few months after Porte and Rennie were demobilized. With their departure from Felixstowe there was no technical officer to supervise the experimental flying, and it seems possible that the Fury's load was incorrectly disposed. The pilot, Maj. Ronald Moon, apparently lifted the boat off the water before its minimum safe flying speed had been reached. With no reserve power available the craft stalled, stove in its hull on striking the water, and sank; Moon and two of his crew lost their lives.

Just as the Curtiss company had adopted the Porte type of construction for the H.16 flying-boat, so also did the Norman Thompson company in England. After producing a series of boats which were generally similar to the Curtiss machines in appearance and construction, the Bognor Regis concern built two prototypes, designated Norman Thompson N.2C. This type was a development of the Norman Thompson N.T.4A, and had the same flight organs; but the N.2C had a Porte-type hull in place of the boat-built hull of the N.T.4A. This design was probably influenced by the production of F.2A hulls in the Norman Thompson workshops.

As remarked earlier, Service needs for flying-boats were drastically reduced with the coming of peace. Production virtually ceased, and the F.3 was soon withdrawn in favour of the F.2A and F.5. The F.3 was declared obsolete in September 1921, and several were sold abroad. Portugal and Spain used the type: a Portuguese F.3 made the first flight from Portugal to Madeira on March 22nd, 1921, covering the 530 nautical miles in 5½ hours; and three F.3s were carried aboard the Spanish aircraft carrier *Dedalo*. Some of these F.3s were reconditioned by Fairey Aviation before going abroad. Farther afield, two F.3s, adapted to carry six passengers or a ton of freight, were used for commercial purposes in Tasmania.

The R.A.F.'s use of F.5s was unspectacular, for no flying-boats were needed to patrol waters no longer infested by U-boats. A fine flight was made in the summer of 1919 by N.4044, one of the first F.5s to be built. Accompanied by N.4041, this boat left for a tour of Scandinavia in July 1919. N.4041 was recalled, but N.4044 continued alone and completed an uneventful and trouble-free tour which lasted 27 days and covered 2,450 miles.

Experiments continued. An F.5 (N.4838) was flown at the Isle of Grain with experimental aileron balances consisting of small auxiliary aerofoils, similar to those used on the Avro Manchesters and the third Bristol Badger.

Two experimental hulls were tested on F.5 aircraft. The first to appear was N.178, which had a deep, hollow-bottom hull made by Saunders; standard F.5 flight organs were fitted, the mainplanes being rigged with a slight stagger. The second experimental F.5, N.117, was of considerable significance, for it was claimed to be the first military flying-boat in the world to have an all-metal hull. This hull was made by Short Brothers, to whom the aircraft was known as the Short S.2, and was an early example of a metal monocoque. Standard F.5 wings and tail surfaces were fitted: these included horn-balanced elevators. The Short S.2 hull had a fluted planing bottom, and its strength was proved when, near the west coast of France, the aircraft stalled into rough water from a height of about 30ft. The hull remained undamaged and completely watertight.

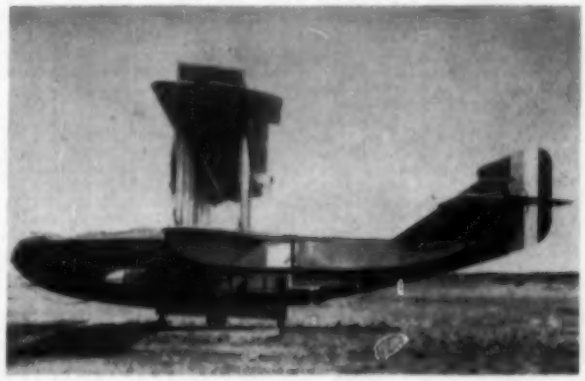
In 1921, fifteen F.5s were bought by Japan. These flying boats gave excellent service with the Imperial Japanese Naval Air Service, and were put to good use by the British Air Mission which went to Japan in 1921. Some impressive long-distance flights were made, and in some cases the Japanese F.5s were airborne for over nine hours.

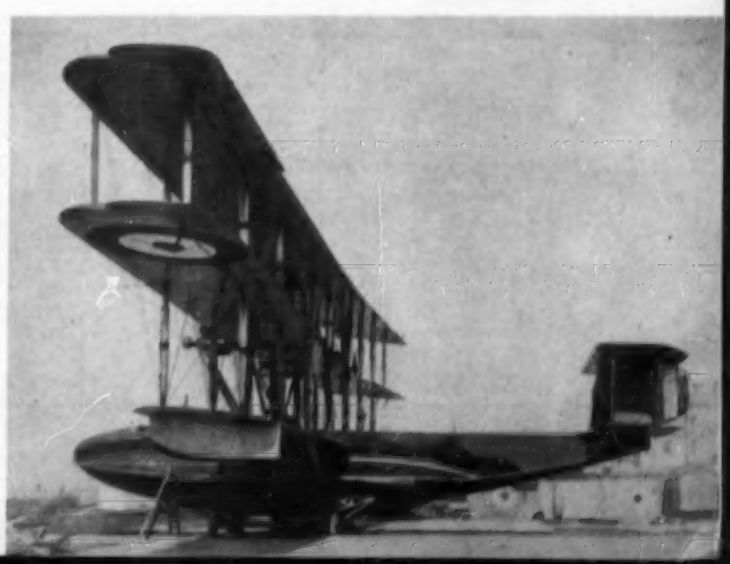
One of the first airlines to be operated by flying-boats was the Key West to Havana route of Aeromarine West Indies Airways Inc. The aircraft were two modified F-5Ls which had accommodation for twelve passengers in two cabins in the hull, to which circular windows were fitted. The machines were modified late in 1919 by the Aeromarine Plane and Motor Company of Keyport, N.J., and were designated the Aeromarine Model 75. The airline's passengers were mostly thirsty Americans seeking the type of refreshment denied them by Prohibition, but the withdrawal of airmail subsidies in 1923 brought about the collapse of the venture.

An F-5L was used to test an early radio compass on July 6th, 1920, when the aircraft flew from Hampton Roads to U.S.S. *Ohio* at sea with the aid of the instrument; the distance was 95 miles.

But John Porte was not to see the modest peace-time successes of his flying-boats. He left the R.A.F. as W/C. Porte, C.M.G., and in August 1919 he joined the Gosport Aviation Co., Ltd., as chief designer. For that company he produced a series of designs based on his Felixstowe types. Perhaps the most interesting of these was the Gosport G.9, which was simply a commercial version of the Felixstowe Fury, powered by three 600 h.p. Rolls-Royce Condor engines—the installation originally intended for the Fury. The G.9's engines were arranged as two tractors and a central pusher unit.

Neither the G.9 nor any other Gosport type was built, how-





(Reading downwards) America's Curtiss H.16, showing the adoption of a Porte-type hull; the Porte Super Baby, or—officially—Felixstowe Fury; and the same aircraft with its modified tail unit.

This photograph of the Curtiss four-engined triplane flying-boat being assembled at Felixstowe makes a curious contrast with modern erection methods. Note the wooden scaffold-poles.

THE FELIXSTOWE FLYING-BOATS . . .

ever. Worn out by the strain of intensive work, occasional operational flying, and even of fighting litigation against him, John Porte died suddenly at Brighton in October 1919. He was not quite 36 years old.

Before his death he had seen the Atlantic flight accomplished by a flying-boat: that was in May 1919. The boat, designed by the Aircraft Division, Bureau of Construction and Repair, U.S. Navy Department, had been built by the Curtiss Engineering Corporation. It was one of a Flight of four which had been led by Cdr. John H. Towers, U.S.N., who, as a lieutenant, had been concerned with an earlier Curtiss flying-boat less than five years before. Then, too, the objective had been the Atlantic flight.

John Porte's contribution to victory was assessed with nice parsimony by the Royal Commission on Awards to Inventors: his widow received the sum of £1,500 in respect of his work on the development of flying-boats. Doubtless the official view was that what he did was in the normal course of his duties.

But the final word and, perhaps, the best assessment can be left to Sir Walter Raleigh. Writing of John Porte in *The War in the Air* he said: "The shortest possible list of those who saved the country in its hour of need would have to include his name."

DATA ON THE FELIXSTOWE FLYING-BOATS

MANUFACTURE

All prototypes were built at the Seaplane Experimental Station, Felixstowe. Production was undertaken by the following contractors: The Aircraft Manufacturing Co., Ltd., Hendon, London, N.W. (May, Harden and May, Southampton Water): Porte Baby, F.2A and F.5. Dick, Kerr and Co., Ltd., Preston: F.3. The Gosport Aircraft Co., Ltd., Gosport: F.5. Dockyard Constructional Unit, Malta: F.3. The Phœnix Dynamo Manufacturing Co., Ltd., Bradford: F.3. S. E. Saunders, Ltd., East Cowes, Isle of Wight: F.2A and F.5. Short Brothers, Ltd., Rochester: F.3 and F.5. The Norman Thompson Flight Co., Bognor Regis: F.2A hulls. Canadian Aeroplanes, Ltd., Toronto, Ontario, Canada: F.5. U.S. Naval Aircraft Factory, League Island, Philadelphia, Pennsylvania: F-5L.

POWER UNITS

F.1: Two 150 h.p. Hispano-Suiza. *Porte Baby:* Three 250 h.p. Rolls-Royce; two 250 h.p. Rolls-Royce and one 260 h.p. Green; three 345 h.p. Rolls-Royce Eagle; three 360 h.p. Rolls-Royce Eagle VIII. *F.2:* Two 250 h.p. Rolls-Royce. *F.2A:* Two 345 h.p. Rolls-Royce Eagle VIII. *F.2C:* Two 275 h.p. Rolls-Royce Mk. II (322 h.p. Eagle VI). *F.3:* Prototype, two 320 h.p. Sunbeam Cossack; production, two 345 h.p. Rolls-Royce Eagle VIII. *F.5:* Two 325 h.p. Eagle VII; two 350 h.p. Rolls-Royce Eagle VIII; two 400 h.p. Liberty 12. *F.5L:* Two 400 h.p. Liberty 12. *Felixstowe Fury:* Five 334 h.p. Rolls-Royce Eagle VII; five 365 h.p. Rolls-Royce Eagle VIII.

ARMAMENT

Porte Baby: Several machine-guns were carried. The Babies with lengthened forebody had a ring-mounting near the bows, and guns were presumably fitted to mountings in the hatchway behind the cockpit. The prototype Baby at one time had a six-pounder Davis gun on the bows.

F.2A: Normally four Lewis machine-guns: one on a ring-mounting on the nose cockpit, one in upper rear cockpit behind the wings, and one in each waist position. Some machines had twin Lewis guns in the nose and upper rear cockpits, and an additional gun was occasionally mounted on top of the cabin structure. Two 230-lb bombs in racks under lower wings.

F.2C: Two Lewis guns on ring-mounting on nose cockpit; two 230-lb bombs in under-wing racks.

F.3: Generally as for the F.2A, but four 230-lb bombs could be carried.

F.5: As for F.2A and F.3, but there were schemes to mount a Davis gun in the bows. Four 230-lb bombs in under-wing racks. The Canadian-built F.5 could have up to eight Lewis guns.

F-5L: Normal armament consisted of one Davis and four Lewis guns, four 230-lb or two 500-lb bombs; maximum defensive armament could consist of the Davis gun and eleven Lewis guns.

Felixstowe Fury: Four machine-guns and a substantial load of bombs could be carried.

SERVICE USE

Porte Baby: R.N.A.S. Stations, Felixstowe and Killingholme. *F.2A:* R.N.A.S. Stations at Felixstowe, Great Yarmouth, Killingholme, Cattewater, Dundee, Scapa Flow. *F.3:* As for F.2A; also used in the Mediterranean, probably from Taranto. *F.5:* Seaplane stations at Felixstowe, Calshot, Mount Batten, Great Yarmouth. No. 230 Squadron, R.A.F. (later No. 480 Flight) Calshot. Navigation Training Flight, Calshot.

ALLOCATION

On October 31st, 1918, the R.A.F. had two Porte flying boats (possibly Babies, or one Baby and the Fury), 53 F.2As, and 96 F.3s on charge. All the F.2As and 29 F.3s were at seaplane stations in the United Kingdom; of the remaining F.3s, 18 were attached to the Grand Fleet, 13 were in the Mediterranean, one was at an Aeroplane Repair Depot, 18 were with contractors, and 17 were in store.

SERIAL NUMBERS

3580: F.1. 9800-9820: Porte Baby. N.64: F.3 prototype. N.65: F.2C. N.90: F.5 prototype. N.4000-N.4049: ordered from Short Bros. as F.3s; some delivered as F.5s. N.4080-N.4099: ordered from S. E. Saunders as F.2As; some delivered as F.5s. N.4100-N.4159: ordered from Dick, Kerr and Co. as F.3s. N.4160-N.4179: ordered from Phœnix Dynamo Mfg. Co. as F.3s. N.4180-N.4229: ordered from Phœnix Dynamo Mfg. Co. as F.3s, some delivered as F.5s. N.4230-N.4279: ordered from Dick, Kerr and Co. as F.3s. N.4280-N.4309: ordered from S. E. Saunders as F.2As. N.4310-N.4321: F.3s built at Malta Dockyard. N.4370: F.3 built at Malta Dockyard. N.4400-N.4429: ordered from Phœnix Dynamo Mfg. Co. as F.3s. N.4430-N.4479: ordered from S. E. Saunders as F.2As; some delivered as F.5s. N.4480-N.4504: ordered from Aircraft Manufacturing Co. as F.2As; some delivered as F.5s. N.4510-N.4519: ordered from Aircraft Mfg. Co. as F.2As. N.4530-N.4554: ordered from Aircraft Mfg. Co. as F.2As. Between and about N.4560 and N.4568 were F.2As. N.4580 was an F.5 built by Saunders. N.4584 was an F.2A. N.4629 was an F.5, believed built by Saunders. N.4630-N.4637 at least were F.5s built by Gosport Aircraft Co. N.4838 and N.4839 were F.5s.

NOTES ON INDIVIDUAL MACHINES

F.2As used at Great Yarmouth: N.4283, N.4289, N.4291, N.4295, N.4298, N.4303, N.4305, N.4511, N.4512, N.4549 and N.4550.

F.2As used at Felixstowe: N.4302 and N.4533. N.4545 had open cockpits. The F.5, N.4838 had experimental ailerons.

COSTS

F.2A flying boat including hull and trolley, but without engines, instruments and guns, £6,738. Rolls-Royce Eagle VIII engine, each, £1,622 10s.

DIMENSIONS, WEIGHTS AND PERFORMANCE

Aircraft Type	Porte Baby Production	F.1	F.2A	F.2C	F.3 Prototype (Sunbeams)	F.3 Production, Normal Load	F.5 Prototype, Normal Load	F.5 Production, Normal Load	F-5L	Felixstowe Fury, Medium Load
Span (upper wing)	134ft	73ft	95ft 7½in	95ft	101ft 8in	102ft	103ft 8in	103ft 8in	103ft 9in	123ft
Span (lower wing)	—	46ft	68ft 5in	—	—	74ft 2in	74ft 2in	74ft 2in	—	—
Length	63ft	—	46ft 3in	46ft	45ft	49ft 2in	49ft 6in	49ft 3in	49ft 3½in	63ft 2in
Height	25ft	—	17ft 6in	17ft 3in	18ft	18ft 8in	18ft 5in	18ft 9in	18ft 9½in	27ft 6in
Wing area (sq ft)	2,364	—	1,133	1,136	1,429	1,432	1,409	1,409	1,397	3,108
Weight empty (lb)	14,700	—	7,349	6,768	8,270	7,958	8,023	9,100	8,250	18,563
Military load (lb)	1,418	—	1,305	1,122	900	2,101	2,148	720	—	1,360
Fuel and oil (lb)	2,482	—	2,124	2,350	2,455	2,096	2,097	2,842	—	5,130
Weight loaded (lb)	18,600	—	10,978	10,240	11,625	12,235	12,268	12,682	13,000	25,253
Max. speed (m.p.h.) at 2,000ft	87.5	—	95.5	98	88.5 (at 400ft)	93	102	88	87	97
6,500ft	72	—	88.5	94	—	91.5	99	86	—	93
10,000ft	—	—	80.5	91	—	87.5	90.5	—	—	89.5
Climb to 6,500ft (min and sec)	25 00	—	16 40	18 20	27 00	24 00	16 05	30 00	(10 min to 2,625ft)	14 00
Climb to 10,000ft	—	—	39 30	38 00	60 00	—	32 30	—	—	28 20
Service ceiling (ft)	8,000	—	9,600	10,300	—	8,000	11,100	6,800	—	12,000
Endurance (hours)	—	—	6	—	—	6	7	—	7.9	—

NAPIER TURBINES FOR HELICOPTERS

Dr. A. W. Morley's Lecture to the Helicopter Association

THE original work of the Napier Company in the field of helicopter powerplants was the subject of a paper read by Dr. A. W. Morley, Ph.D., M.Sc., A.C.G.I., A.F.R.Ae.S., the company's forward-projects engineer, before the Helicopter Association of Great Britain on December 10th. The paper, a synopsis of which follows, was concerned with the application of the gas turbine to helicopters from the point of view of the engine designer.

It is appropriate that in this issue, on pages 938-942, we describe the Hunting Percival P.74 helicopter (two Napier Oryx turbines), whose design owes a great deal to the work of the Napier company.

Special attributes of the gas turbine engine which make it attractive for helicopter propulsion [said the lecturer] are its low weight per horse-power, freedom from vibration, simplicity of installation, low frontal area and bulk, the freedom of choice in rotor speed, and its ability to make use of fuels carrying less fire risk than petrol.

Types of Installation with Gas Turbine.—The gas turbine can be used in the helicopter to power the rotor in two distinct ways: by direct mechanical drive, or by tip-jet reaction. In the former, continued the lecturer, there is a mechanical drive, typical of piston-engined helicopters, to the rotor *via* reduction gear. An example is a development of the Bristol 173 twin rotor helicopter powered by two Napier Gazelles. In the second class we have the reaction drive of the rotor by means of tip-jets. Power output can take the form of compressed air (extra fuel perhaps being burnt at the discharge nozzles), or by using a slightly different thermodynamic cycle, where the rotor discharge can include all the gas in the engine efflux including the turbine exhaust, the rotor receiving its energy in the form of gas horse power, as in the Hunting Percival P.74 and P.105 helicopters (Napier Oryx).

A further example of the second class of turbine installation is a combination of rotor drive by tip-jets with normal forward airscrew drive through reduction gears. This type of craft can take off and land like a helicopter and cruise almost as a fixed-wing aircraft (*vide* the Fairey Rotodyne powered by the Napier Eland).

The most important question at the inception of a helicopter design, said Dr. Morley, is the choice of the best number of engines. Some of the general problems include (a) the necessity for comprehensive engine control; (b) emergency power requirements; (c) dirt accumulation on the compressor blades; and (d) the novel situation of the engine.

The lecturer then discussed each of these problems in turn: (a) The narrowness of the turbine's stable operating range means that changes in operating conditions must be met smoothly and rapidly by automatic control. Flexibility depends upon full use being made of the compressor's better performance near the surge line without actually running into surge. The quick changes that must be met when one engine cuts, and full power is required from the remaining engines, can only be effectively carried out by an automatic control. With a satisfactory control system the gas turbine has ample flexibility.

Turning to emergency power requirements, (b), the lecturer said that eventually the great majority of helicopters would be multi-engined with ample reserves of power. At present, for example, if a fully-loaded two-engined helicopter climbing at zero forward speed suffers an engine failure it is likely to be left with insufficient power unless the remaining engine can give 30 per cent above its maximum take-off power. Such an over-load would only be needed for a short period until a moderate forward speed was reached.

An efficient engine control system would lose no time in carrying out the engine running changes and the overload would last but a few seconds, being needed again only on landing.

It is, therefore, most desirable for the engine manufacturer to guarantee the required emergency power to avoid the additional weight and complexity of emergency propulsion equipment. It is likely that a helicopter engine will be uprated for the emergency requirement above the comparable take-off power of fixed-wing aircraft, since overload times will be short and required rarely, adding up to a much less total time than the maximum power periods needed for every take-off of a fixed-wing aircraft. The speaker pointed out that in a jet reaction rotor-drive emergency power cases can be met by tip-burning.

The problem of dirt accumulation on compressor blades (c) was considerable, since helicopters spent most of their time flying near centres of population in polluted air, resulting in deposits of solid matter on the compressor blades affecting their aerodynamic properties. This can be removed by the injection of a suitable turbo-cleansing concentrate.

On the subject of the novel situation of the engine (d) Dr. Morley said that the easiest way to install an engine is vertically, with the power drive at the top from what is normally considered to be the rear end of the engine, special arrangements having to be made for the compressed air intake at the bottom.

The Napier Gazelle.—The Gazelle, said the lecturer, has not yet been released for publication, and only brief mention of it can be made. It is a free turbine unit of 1,250 s.h.p. intended for mechanical drive and designed from the start for helicopter use—in particular with regard to its control system and power rating.

The Napier Oryx and the Hunting Percival helicopters.—The lecturer praised the work of the Hunting Percival company who pioneered the form of helicopter which uses the Oryx. The design of the Oryx was crystallized in May 1952, and the engine first ran in December 1953, after extensive component tests. Many

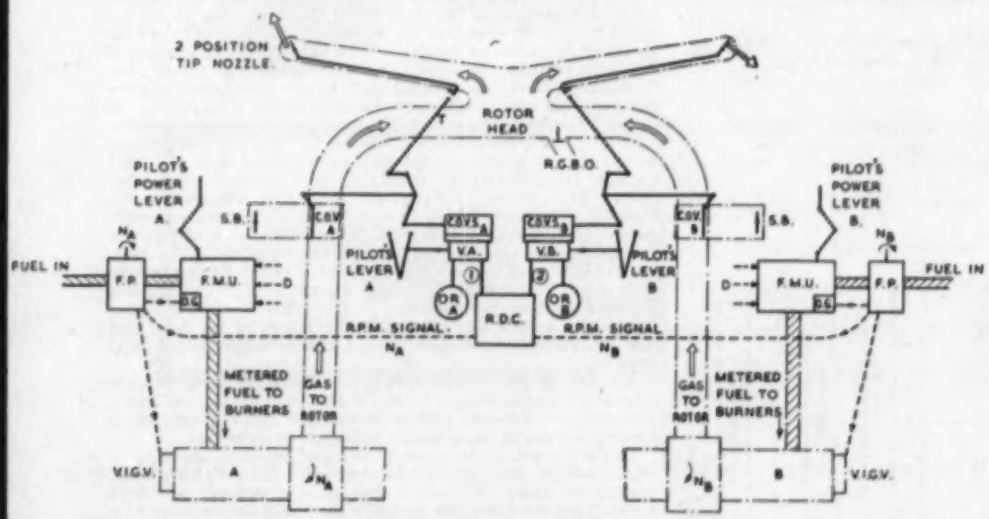
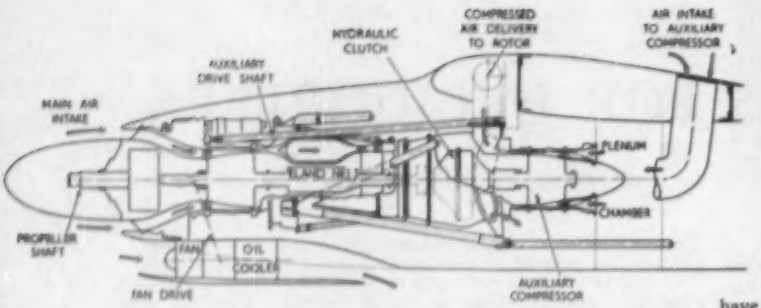
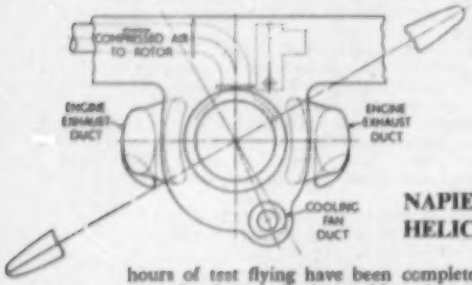


Diagram of the engine control system of the Hunting Percival P.74 helicopter (described on pp. 938-942).

F.M.U.	Fuel metering unit.
F.P.	Fuel pump.
O.G.	O'speed governor.
A., P.	Twin Oryx engines.
V.I.G.V.	Variable inlet guide vanes.
D.	Data fed in (ambient pressure and temperature: turbine inlet temp.).
C.O.V.	Change-over valve.
C.O.V.S.	Servo to operate C.O.V.
(1)	Oil pressure admitted to shuttle valve VA if (N_B—N_A) is in excess.
(3)	Oil pressure admitted to shuttle valve VB if (N_A—N_B) is in excess.
OR A, OR B	Oil pressure accumulators for C.O.V. servos, engines A and B.
VA, VB	Shuttles controlling C.O.V. servos and overriding pilot.
R.D.C.	R.P.M diff. control.
S.B.	Starting butterfly and atmospheric discharge.
T.	Trip release (causes partial closure of tip nozzles when either C.O.V. opens).
R.G.B.O.	Rotor gas blow-off, cont. by rotor speed.





Installation diagram of the Napier Eland NEI.3 in the Fairey Rotodyne.

NAPIER TURBINES FOR HELICOPTERS . . .

hours of test flying have been completed and a helicopter test tower has been built thoroughly to investigate the control system. Oryx propulsion cycle is familiar to most engineers as the by-pass system in which a secondary compressor uses up surplus power in the turbine to compress further air which is mixed with the exhaust, augmenting its flow and diluting its temperature. For the helicopter by-pass flow should be about 50 per cent of the main compressor flow. A satisfactory pressure ratio is 6:1 permitting a two-stage turbine and producing exhaust gas at a suitable temperature for the rotor. Absolute delivery pressure of the Oryx is about 1.6 atmospheres at 400 deg C. The whole design implies a delicate compromise between engine and aircraft designers so that the engine's qualities are best exploited. Great care must be taken in the ducting arrangements, for example, and delivery flow must satisfy the flow capacity of the rotor duct, i.e., mass flow rate, temperature and pressure must be appropriate to rotor r.p.m. and its tip-nozzle area.

Since the tip-nozzle area is the controlling factor, its interrelation with engine speed and rotor speed is continuous and must be so designed as to get the best out of the helicopter. It is found in the case of the Oryx for the Percival P.74 helicopter, where the two engines share common rotor ducts, that the simplest solution of the final nozzle control problem is a two-position control, full open for operation on both engines and part closed for the single engine case. With careful choice of the areas for the two positions the matching can be very satisfactory apart from near the extremes of the running range where a rotor gas blow-off must be arranged. The blow-off valve can be controlled according to rotor speed only.

For starting purposes, particularly in a multi-engine single rotor system, it is necessary to isolate each engine from the rotor while it is being brought up to speed and delivery pressure, and then to bring it in fairly smartly yet smoothly, so that there is no tendency for the engine to surge. The Oryx is therefore fitted with a two-way change-over and non-throttling valve leading either to atmosphere, or to the rotor.

The lead to the atmosphere contains a butterfly valve [see p. 938] with two settings: "start" and "run." The "start" is fully open and the "run" is given a flow area equivalent to that of the rotor ducts. Thus when the second engine has been brought up to the same speed as the engine already delivering to the rotor it will also have the same delivery pressure and can therefore be diverted to the rotor without affecting the running conditions of either engine. The change-over valve is thus operated to open to the rotor when the gas delivery pressure is balanced by the rotor pressure.

Similarly in flight if one unit suddenly loses speed and is no longer discharging to the rotor, its change-over valve automatically closes to prevent useful rotor gas disappearing into the failed engine. The control, on single-engine failure, senses the discrepancy in engine speed and moves the two-way valve of the failed engine to isolate it from the rotor and allow discharge of any remaining output overboard. At the same time the final nozzle at the rotor tip is brought into the part-closed position. With one engine only in operation the rotor head pressure will be unchanged, and due to the somewhat lower duct losses the rotor power is more than half that for two engines. To free the pilot from having to manipulate engine controls during the process they must be fully automatic. The changes may have to be made so rapidly that it is doubtful if any pilot, however well drilled, could cope successfully. [See diagram on previous page.]

In the later developments (the Hunting Percival P.105) an alternative rotor duct system will be used in which each engine delivers to separate ducts right up to the rotor tips, thereby eliminating the need for automatic control of the changeover valve on engine failure.

On the question of starting the Oryx in flight, the lecturer noted that the development of light silver-zinc alkali batteries with greatly increased capacity for short periods marks a big step forward in electric starting.

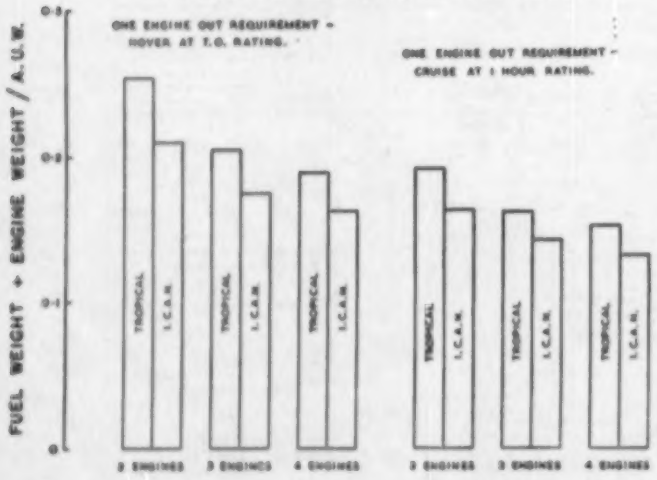
The Napier Eland and the Fairey Rotodyne.—In the Fairey Rotodyne two Elands have the dual task of providing a gas drive for the rotor and mechanical drive to airscrews for forward flight. In this condition all the power goes to the airscrews and the rotor revolves freely in autorotation supplying about half the total lift of the aircraft. The Eland concerned was virtually standard up to the rear flange of the turbine casing and provides about 100 s.h.p. more since there is no requirement for jet thrust. From the turbine rearwards a direct 1:1 drive is taken through a clutch to a large axial compressor which absorbs the bulk of the total engine power at maximum r.p.m. This compressor draws air from the atmosphere and delivers it to the rotor, tip-burning being incorporated. Pressure ratio of the compressor is 4:1, about the optimum for tip-burning. The clutch is arranged so that engine power can be taken off the airscrews and put on to the rotor, or vice versa, at the will of the pilot.

When tip-burning is not used, as in the Oryx-driven rotor, the rotor horse-power is a maximum when the product $Q \quad ^{3}$ and R/V_O is a maximum. For best rotor efficiency the velocity V_O, which is the free discharge jet velocity of the compressed air or gas, must be as low as possible. This condition would require a low rotor pressure. However, in the compressed air system, the tip-burning forms an essential part of the installation, and to burn with reasonable efficiency the air pressure is increased. A number of other factors enter into the choice of the best pressure such as the best overall dimensions for the auxiliary compressor, the rotor duct design, including the rotor head flow path and running seals, and finally rotor tip Mach number. The same fuel, aviation kerosine, is used for the main units and the tip burners. The rotor fuel is provided by a high pressure booster pump. The control system has to be such that during the change to single-engine operation the aircraft remains directionally stable with sufficient lift to maintain height or to descend at an acceptable rate. The engine designer's contribution to this general handling problem is to see that the flexibility of the one power unit is not in any way affected by the failure of the other and that the changes in engine settings can be made quickly and smoothly.

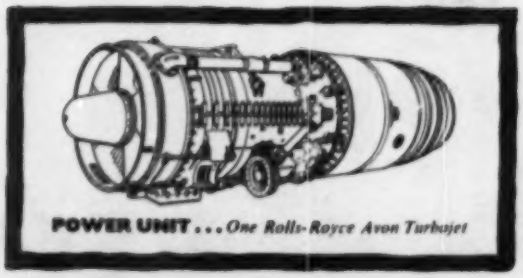
In limiting our paper [concluded Dr. Morley], to a fairly general discussion of three known helicopter turbines, it is hoped that sufficient has been said to satisfy some curiosity concerning engineering problems of future helicopter installations.

In the opinion of the speaker the novel problems are those of engine control, and these are far reaching. They are formidable enough to make it obvious that only a proved unit with unrestricted flexibility can be really successful in a turbine helicopter. The same problems have important repercussions in the design of the airframe.

Typical comparative values of engine weight plus fuel for a 2 hr 5 min excursion for multi-engined turbine helicopters.



THE *FAIREY* DELTA 2



POWER UNIT . . . *One Rolls-Royce Avon Turbojet*

How to go faster: the basic unchanging problem of aircraft design. Mach 1 is no longer the target; but higher Mach numbers present entirely new obstacles. The Fairey Delta 2 will play a part in the investigation and solution of these problems at newly-attainable speeds, showing the way to aircraft for the future needs of N.A.T.O. and the Western world.

THE FAIREY AVIATION COMPANY LIMITED · HAYES · MIDDLESEX

de Havilland send greetings to all their friends and wish them a Merry Christmas and a Happy and Prosperous New Year

This de Havilland photograph shows the site of Verulamium, the third largest city in Roman Britain, six miles west of Hatfield.

The Queen arrives, passing before a guard of honour of airline crew-members. Escorting her is Capt. J. T. Percy, a senior captain of B.O.A.C. On the right, Her Majesty makes her speech; listening is Mr. Boyd-Carpenter, Minister of Transport and Civil Aviation.

THE QUEEN AT LONDON AIRPORT

Inauguration and Naming of the Newest of the Three Main Buildings

THAT the prosaically named Eastern Apex Building in the London Airport central terminal area is henceforth to be known as Queen's Building was disclosed last Friday afternoon, when Her Majesty the Queen, accompanied by H.R.H. the Duke of Edinburgh, inaugurated the central area and named the new building.

Arriving shortly before 3 p.m., the royal visitors were welcomed by Lord Latham, Lord Lieutenant of Middlesex, Mr. John Boyd-Carpenter, Minister of Transport and Civil Aviation, and Air Marshal Sir John D'Albiac, Commandant of the Airport. The Queen inspected a guard of honour of 30 civil aircrew members outside the new building, and twelve stewardesses formed an avenue for the royal approach to the entrance hall.

The inauguration ceremony took place in the exhibition hall of the Eastern Apex Building, Her Majesty unveiling a plaque commemorating the occasion.

After the National Anthem, prayers were said by the Bishop of Kensington. Mr. Boyd-Carpenter then made a brief introductory speech, during which he referred to the growth of traffic at L.A.P. The Queen began her speech by saying that the inauguration marked an important stage in the history of the airport. In the ten years which had passed since the earliest development of the site, the airport had grown in size and in international fame until today they could say with pride that it ranked among the foremost in the world. "For centuries," said the Queen, "London has been a port from which vessels have set out for the farthest corners of the earth. It has been—and is—a great centre of commerce. In the new era of flight, which has transformed our world in less than half a century, London has acquired a new importance."

Her Majesty went on to express her pleasure at seeing how much had been done to fit the airport for its great task: "No other airport in the world sees such a volume of international traffic. The airlines of 25 nations meet here in friendly and peaceful rivalry. London Airport has become the modern meeting place where many tongues are spoken in friendship and goodwill. Here is daily proof that air travel has brought all lands close together, and made all men neighbours . . . I congratulate all who have taken part in the arduous work of preparing and draining the land, and who have planned and built on it the eight miles of runways and the modern and efficient buildings which we see about us."

After commenting on the efficiency of the control system, Her Majesty said: "I am especially glad to have this opportunity of expressing my admiration for all that has been achieved, because my husband and I are regular travellers by air, and we look forward to our first departure from these new buildings next month." [This was clearly a reference to the royal tour of Nigeria, which will begin on January 27th, when the Queen and the Duke leave London Airport in a B.O.A.C. Argonaut.]

After saying that she was sure the airport would continue to grow in importance as one of the world's centres of air traffic, Her Majesty formally named the building "Queen's Building."

When this brief ceremony was ended, the Queen left by the east door into the grill room and, together with the Royal party, made a tour of the terminal area, where Customs, immigration and other officials were presented. The control tower was also included in the tour, and the Queen returned to the restaurant and balcony lounge from the roof terrace in order to take tea with guests.

Queen's Building is the third structure in the impressive group which dominates the diamond-shaped central terminal area. Its main purpose will be to accommodate operational staffs, but it will have a number of facilities for the public, including an exhibition hall, post office, news cinema, lecture hall, grill room and buffets. There is also a terraced roof garden, from which the public will be able to watch the airfield traffic. The exhibition hall on the first floor is an impressive room with a long wall of glass overlooking a roof garden. Visitors entering by the stairway from the main entrance will pass through it to the grill room, or through pay barriers to the roof gardens.

The grill room, which is air-conditioned, occupies half the sweeping low front on the eastern side of the building. The tables are arranged in a series of four tiers, and the main window is so shaped as to prevent reflection interfering with the view of the airfield. Facilities include a cocktail bar and a sprung dance floor, and adjacent is a series of private dining rooms. The roof gardens are arranged with terraces on five different levels overlooking the tarmac.

The single-storey area on the south of the building houses offices for meteorological staffs and for aircrew briefing. The corresponding area on the north side incorporates operations offices used by the main companies. Also in this area are rest and refreshment facilities for aircrews.

The Queen, watched by the Duke, unveils the commemorative tablet.

DEADBEAT NEWS

FOUNDED BY THE CHAIRMAN · SIR JAS. DEADBEAT

DEADBEAT DEARDEN

Notable Success for Chairman's Son

Mr. Milroy Deadbeat Appointed to Board: No Favouritism for my Boy—Chairman

We are pleased to announce the appointment of Mr. Milroy Orpheus Deadbeat, Hon. B.A. (Oxo), son of our Chairman, to the Board of Directors of the Company. As emphasized by his father in making the announcement, Mr. Deadbeat the younger has had no assistance whatsoever in working his way, slowly but surely, to the top.

He began on the shop floor on coming to the Company from Oxbridge University in November, 1955. After a week he was appointed Shop Foreman, which rank he held for four days before being promoted Senior Shop Foreman. After six days in this office he was made Deputy Assistant Production Manager, rising to Assistant Production Manager three days later. After a long and arduous apprenticeship in the design office (as Assistant Chief Designer for four days) he rose to be Special Assistant to the Company Secretary (Complaints Dept.). Some two days later he was appointed Personal Assistant to the Chairman, and Adviser to the Board on Technical Affairs, which remains his present position.

D.N. Hears That:

. . . the machine-shop tea-makers' outing to Southend was a great success. An enjoyable and convivial time was enjoyed by all. But who put the bloater in Henry Twofist's hat? Sounds a fishy story to us, eh, Henry? ha, ha!

* * *

. . . the lunch-time Thé Dansants in the cribble - beam assembly shop canteen are proving a great success. But a little bird tells us that romance has sprung up between a certain cribble-beam-end fitter's mate and a certain progress chaser's card shuffler. . . . What about it, Ron and Mabel? Wedding bells soon, perhaps, eh?

* * *

. . . an embarrassing but humorous incident occurred on the occasion of the D.O. senior staff dinner which was held at Thrugley's restaurant on Friday last. When the 43 guests and hosts filed into the beautifully decorated blue room (extended by removal of the partition to include the lower cloaks and waiters' room) to dine, it was found that there were but 42 seats at the beautifully decorated table!! "Ah, well," quipped Sir Jas. Deadbeat, our chairman, with customary wit, "One of us will have to stand."

She handled beautifully, pilot reports

DEADBEAT DRAGMASTER FLIES

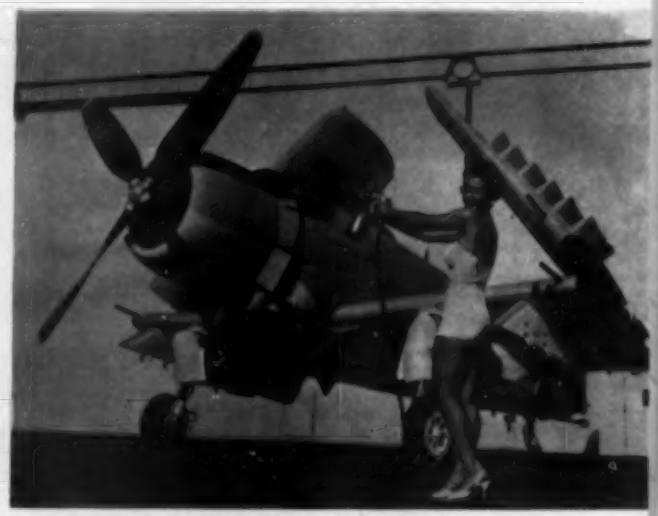
"Symbolic of Great Tradition"—Chairman
Wreckage Cleared from Runway in Record Time: Top Priority for Factory Rebuilding
New Chief Designer Appointed

Amid scenes of unparalleled enthusiasm, the prototype Deadbeat Dragmaster rolled out of No. 2 hangar on Thursday last. Amid scenes of unparalleled excitement, test pilot Graunchly-Hyphenate smiled cheerfully as he climbed into the cockpit. A truly amazing flight ensued.

"This occasion," said Deadbeat Chairman Sir Jas. Deadbeat, "is symbolic of the Company's great tradition."

"She handled perfectly" reported test pilot Graunchly-Hyphenate.

STOP PRESS. Minor Accident. An unfortunate slight accident to the Dragmaster, which occurred during its maiden flight, resulted in the slight demolition of hangars 2, 3 and 4, and a small amount of complete destruction of the main assembly shop. The Dragmaster itself was not entirely undamaged, the aircraft being completely written off. Details of the appointment of our new Chief Designer are given on this page.



View of the main runway at Wandsworth.

In the photograph above our Chairman, in typical informal mood, is seen addressing recipients of long-service awards, who received presentation copies of "Fifty Years a Deadbeat," by our Chairman, Sir Jas. Deadbeat.

NEW CHIEF DESIGNER

D.N. Welcomes Mr. Fishball Wallower

On behalf of our readers, Deadbeat News extends a hearty welcome to Mr. Thos. Fishball Wallower, A.B.C. (Tech.), M. Inst. Phil., recently appointed Chief Designer to the Deadbeat Aircraft Co. Mr. Fishball Wallower has had a distinguished career in sanitary engineering and comes to Deadbeat from the Upper Dorking Urban District Council.

In an exclusive interview with Mr. Fishball Wallower, D.N. special reporter joked "Your career seems to have swung from drains to the aircraft industry, Sir, eh?" The new Chief Designer thought deeply, and then nodded. "Yes, I agree. Drains to the aircraft industry." When asked whether he intended to apply the area-rule concept to investigate transonic kinetic - heating phenomena as related to the quasi-divergent steady-state oscillatory derivatives encountered in simulating aeroelastic distortions of non-linear aerodynamic functions, Mr. Fishball Wallower seemed puzzled. "What has that to do with sanitary engineering?" he enquired. "But, Sir, this is an aircraft factory," we reminded him. "And you are Chief Designer." "Oh, I see," replied Mr. Fishball Wallower slowly.

"FUN & GAMES"

Seen in characteristically gay mood at the stress-office Kiddies' Christmas Party, our Chairman, Sir Jas. Deadbeat, joined enthusiastically in the "fun and games." He later presented each child with a presentation copy of his book "Fifty Years a Deadbeat."

Deadbeat Heritage

Prizewinning Entries in Literary Competition

First Prizewinner:

DEADBEATS ALL AT WANDSWORTH

by Finnegan O'Rollmop
(Despatch Dept. Packer)

When the wind outside is blowing,
And the night-shift lathes are going,
Then its glad I am to be a Deadbeat true.
You can keep your country cottages,
Light bulbs with sixty wattages,
Think of Deadbeat, boys, its here for me and you.

Yes its here in Wandsworth beauteous,
Where we're working for our futeous,
Me and Charlie, Henry, Alfie, George and John.
You can't teach us inefficiency,
For of that there's no deficiency,
So Hurrah for Deadbeat, chaps, say I for one.
[And so say all of us. Well done, Finny!—Ed.]

Second Prizewinner:

FACTORY MOOD

by Herbert McX. Slugge
(Electropneumatic Seat-button Lever-pin Pangle-setting Coagulator Dept.)

Aside the bike, tis time to check
A card and take up daily task
The mighty building hums and I
Switch on my ratchet-lug coagulator
Monotony, tis not for me nor I
For it This day I am alive and yet
I die The reason rushes
To my tortured brow Alas too late
The ever - non - existent whistle blows and
Blowing, bids us rest awhile The mighty
Rows of soldier-like coagulators, dimly
Sensed amid the noisy silences of the
Noontide night imply hostility
I hear you, whistle,
Thou have liquid pools of meaning in
Thy meaning-laden presence Here lies destiny
Oh, coagulator, thou
Art not for September, as it seems,
Why not a bottle full of ink
My heart is full, coagulator, full
And rhyme or reason plain do
Not exist
But I exist and why
The reason springs, coagulator, springs
Up and bids me sing Rejoice
The red-toned fusiness of the infinite
Is here

[Well, that's real contemporary stuff, eh, Herbert? Can't say we really understand what its all about, you know, but we must say we're glad you got it off your chest, ha, ha! Anyway, well done, Herbert, whatever it means.—Ed.]

IT is with the warmest and friendliest feelings of seasonal goodwill that I smilingly greet all members of the Deadbeat ŧshrdlu°¿ppnpf *you all a happy and joyous Christmas. On this happy festive occasion I feel especially proud to be a Deadbeat. I want you to be proud, too. For, after all, our Company is really one big happy family. Let us all be good members of that family. Let us all be worthy of our great tradition. Let us all be Deadbeats together.*

Chairman.

LETTERS TO THE EDITOR

To The Editor, Deadbeat News

May I take this opportunity of expressing my grateful thanks to my colleagues in the Tool Room Records Office who, on the occasion of my recent retirement from the Deadbeat Company, so kindly presented me with a presentation copy of "Fifty Years a Deadbeat," by our Chairman, Sir Jas. Deadbeat. It will always help me to remember "old times" with "the gang" at Wandsworth.

Yours, etc. Harry Iggnotz.

To The Editor, Deadbeat News

I would be glad if you could trace for me the scoundrel who, at the recent stress-office Kiddies' Christmas Party, inflicted on my young daughter, age 7, a copy of the most revolting horror-comic annual I have ever had the misfortune to come across, "Fifty Years a Deadbeat." This monster is obviously out to fill the minds of the young with the most dangerous type of rubbish. If I get my hands on him I'll soon show him what's what, believe you me.

Yours, etc. Josiah Bridgemegger
(Assembly Inspection Dept.)

(Contd. foot of next col.)

[Farewell presentation to Mr. Bridgemegger: page 13.]

DRAGMASTER LEADS

—Chairman

"Our Dragmaster airliner marks a new era in air transport," Sir Jas. Deadbeat stated today. "I am confident," the Chairman continued, "that the Dragmaster will maintain Britain's lead in the production of turbojet, turboprop and piston-engined airliners for outback, feeder, medium-stage and long-haul routes." The Dragmaster, he explained, was the first aircraft designed to meet all these requirements simultaneously.

The Chairman added: "The Dragmaster symbolizes my personal faith in the future of air transport as a safe, economic, normal everyday means of communication." Sir Jas. Deadbeat was speaking on the eve of his departure from Southampton in the *Queen Mary*. Urgent business abroad has forced him to forsake the Yuletide hearth for a three-month visit to Bermuda.

YOUR "OFFICIAL SPOKESMAN"

How Deadbeat's Story is "Put Across" to the Outside World

By GODFREY GUFFE (Assistant Public Relations Manager, Deadbeat Aircraft Co.)

WE of the Public Relations Department like to think our work is just as vital, in an unspectacular way, as the production of aircraft, engines and guided missiles—or whatever it is you people make in that cold, dark, noisy shed place on the far side of the airfield.

Last year, for example, this small department — employing only 239 people, excluding secretaries—wrote 1,397,425 words of brochures and Press handouts and distributed 1,784 tons of publicity material. This material was used by journalists throughout the world, and on a few memorable occasions the name of Deadbeat actually appeared in print.

Which of us will forget the great day when the *Liberian Local Government Chronicle* published the full text of our Chairman's 15,000-word address on the occasion of the Deadbeat apprentices' prizegiving ceremony? The fact that his photograph was printed in an inverted position was taken by Sir Jas. Deadbeat in characteristically good humour. It is indeed symbolic of the great Deadbeat tradition that the subsequent legal proceedings against the publishers were settled out of court for a nominal sum of £10,000.

Another achievement which springs to mind is the generous coverage accorded by *Pravda* and the *Daily Worker* to Sir Jas. Deadbeat's remarks on trading profits on the occasion of our Guided Missile company's Annual General Meeting.

The work of the Public Relations Department is not without its difficulties. One of our worst problems is the noise made by Deadbeat aircraft moving about the nearby airfield. Another is that of dealing with constant interruptions by journalists in search of information.

The Deadbeat method of handling journalists follows the famous policy evolved by our "Chief," Mr. Reilly-Smoothe:—

1. Never divulge facts, i.e., specific information which might assist competitors, such as number of hours flown by an aircraft, delivery dates, reasons for modifications, details of tests, performance under realistic conditions, etc.

2. Reserve all worthwhile information and pictures for *Deadbeat Heritage*, our company's glossy bi-annual prestige journal. This ensures fair, unbiased reporting of Deadbeat affairs, without distracting references to competitive companies.

3. The Deadbeat P.R.O. should not attempt to become too familiar with his company's activities, in order to avoid the risk of inadvertently divulging secret information to outsiders.

NAVY HAILS SKYGOOF

"Complete Re-design" Allegation False: Minor Improvements to be Effected.

SPEAKING before last Friday's luncheon meeting of the Battersea Power Station Overseers' Association, Mr. Wolfe S. Reilly-Smoothe, Deadbeat Public Relations Manager, revealed new facts concerning the forthcoming Deadbeat Skygoof all-purpose fighter.

This mighty machine, he revealed, would have a top speed of no less than 400 m.p.h. When asked whether this speed was not already exceeded by fighters in squadron service, he pointed out that, relatively, that was true, but in any case the new machine was being designed for the Navy, where the speed criterion was palpably overshadowed by a host of associated parameters which indeed negatived what might be termed the velocital significance encountered in other applications.

True, there had been minor changes in design, Mr. Reilly-Smoothe admitted; the wing was now high, instead of low, and of 40 per cent greater span; all-up weight had increased by 60 per cent and instead of twin turboprops there were now four turbojets. These were, however, extremely minor changes, and the company had no reason to doubt the integrity of the original design.

Responsible for the design of the Skygoof is Valence R. Koggle, the company's assistant chief designer [details of farewell presentation to Mr. Koggle on page 5].

DEADBEAT AIRCRAFT

(Armaments and Missiles Division), Ltd.

Makers of World's Fastest, Largest, Most Destructive, Northest, Southest, Eastest, Westest, Highest, Lowest, Most Thoroughly Inescapable, Deadliest, Biggest and Best Bombs, Ugliest Rockets, Nastiest Missiles and Most Repulsive Nuclear Devices of All Kinds . . .

wish all readers a happy and peaceful Christmas by their warm and cheerful flaming firesides.

HUNTING PERCIVAL P.74

Research Test Vehicle Approaches the Flight Stage: a New Helicopter Philosophy

THERE are three ways of using a gas turbine to provide power for a helicopter. One is to couple it by shaft drive to the rotor in accepted piston-engine style; another is to draw off compressed air from the engine to supply rotor jets—with or without tip burning; and another is to extend, in effect, the jet pipe to the extremities of the rotors, using the whole through-put of the engine to drive the rotor. Examples of the shaft-drive techniques include the Piasecki Transporter (two Allison T38-A-6), and the Sud-Est 3130 Alouette 2 (one Turboméca Artouste 2); the Westland Whirlwind is also being developed with turbines (one Blackburn Turboméca Twin Turmo), and will be shaft driven, as also will be certain Bristol twin-rotor helicopters (two Napier Gazelles). Compressed-air devotees include the Fairey Rotodyne, the Fairey Ultra-light, and the Sud-Ouest 1120 Ariel, 1220 Djinn, and 1310 Farfadet family.

Last week there emerged from the experimental department of Hunting Percival at Luton the world's first exponent of the third technique—the P.74.

Although each gas-turbine system displays advantages of one kind or another over conventional piston-engine designs, use of rotor jets is undoubtedly the most natural way of exploiting the gas-producing potentialities of a turbine engine. Let gas-pressure energy do the work of a mechanical transmission and immediately the helicopter designer is rid of the mechanical couplings which constitute his major development worry and which, because of the fixed relationship of rotor speed to engine speed, limit the operating efficiency of the helicopter.

The jet helicopter is by no means new—its advantages were foreseen the day the jet was born—and today we see flying, with conspicuous success, such machines as the Fairey Jet Gyrodyne and the French Sud-Ouest company's family of helicopters. It is the Hunting Percival/Napier approach to the jet helicopter which is altogether new. Hunting Percival foresaw in 1950 the aerodynamic advantages of a jet helicopter, and that the best efficiency—weight lifted per amount of fuel burnt—could be achieved by a gas turbine whose sole job in life was to deliver gas horse-power rather than thrust or shaft horse-power. The result is the P.74, and so close has been the partnership between engine and airframe/rotor designers that it is in fact difficult to tell where the Napier Oryx ends and the P.74 begins.

The Oryx has been previously described in detail (*Flight* for August 5th, 1955) and it is necessary only briefly to recapitulate the principle of this fine engine. It is a true gas-producer, in which the power left over from the turbine after it has compressed its own air is used to compress further air. This by-pass air mixes with the turbine exhaust, increasing and cooling the flow for ducting to the helicopter rotor. The engine thus consists of two compressors, each with its own air intake and driven by a common turbine. No further combustion is necessary (although reheat at the nozzles is, of course, practicable) and it is interesting—in view of the criticisms levelled at jet helicopters on the score of noise—that the relatively low-pressure flow is not likely to be too disturbing to the ears. (Experience with the P.74 test rotor, although not truly representative with its Derwent powerplant, has tended to show that nozzle noise is in fact barely distinguishable from the aerodynamic swish of the rotors.) Ground runs of the P.74 complete with rotor are due to begin very soon—rotor-less engine runs were first made on December 2nd—and it will be possible then to verify the belief that the P.74 and its commercial derivative the P.105 will be among the quietest helicopters yet flown.

Before we recount the problems that confronted the Hunting Percival and Napier teams, and describe the way in which they were mastered, it is worth setting out the advantages offered by this new conception of the jet helicopter. Foremost, as already mentioned, clutches, couplings, gearboxes and other mechanisms are eliminated from the scene, together with their associated maintenance, vibration and cooling problems. Secondly, since the rotor is gas-coupled to the engine, its speed is not fixed in relation to it and the optimum rotor speed can be chosen for any condition of flight; hence it is possible to achieve lower rotor r.p.m., and therefore greater aerodynamic efficiency and lift, for the same engine power in hovering flight. Comparative curves of power required against forward speed show that theoretically about 10 per cent less power is required to lift the same weight in the hovering regime (as forward speed increases the two curves tend to converge). The potential superiority in economy is clearly evident.

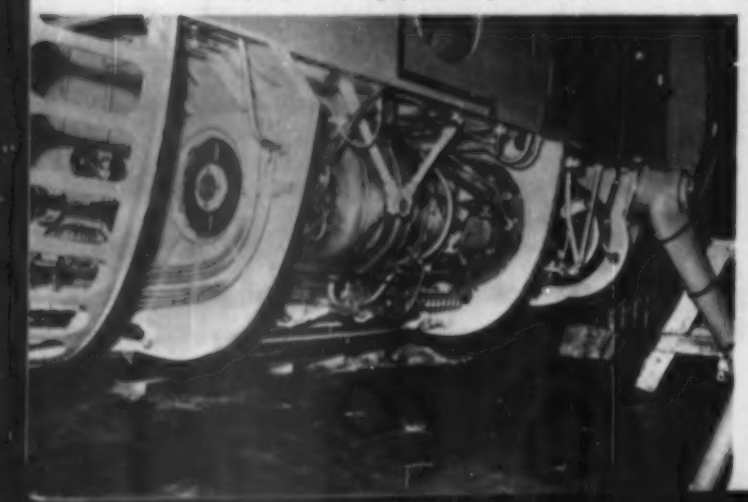
No less advantageous is the fact that the torque between airframe and rotor is of a very low order, consisting only of rotor-bearing and gas-duct friction. Only a small rudder-rotor is necessary for lateral control, and a negligible amount of power is robbed from the main lifting rotor. It is possible that, as a result of P.74 flight trials, a simple fin may be substituted for the rudder-rotor, and the rear fuselage has been made detachable with this possibility in view.

A further virtue of the system is that it makes possible, without recourse to intricate mechanical geometry, the use of a tilting rotor hub. (One tilting-rotor helicopter with shaft drive is successfully operating in the U.S. This is the Doman YH-31 of the U.S.A.F.) As is well known, any inclination of the tip-path plane to the plane of the rotor hub in the classical rotor results in the production of in-plane forces which in turn necessitate the introduction of drag hinges. Being free to tilt, the hub takes up its own position normal to the tip path plane, drag hinges go, the degree of flapping is much reduced, and blade "tracking" tends to be less critical.

There are yet other attractions; the entire gas output of the engines can be spilt overboard before transfer to the rotor, enabling a full-power check to be carried out by the ground crew without the aircraft becoming airborne; engine and reduction-gear cooling—of special concern to a fully laden hovering helicopter—is no problem; the turbines, being outside the cabin as they are to be on the P.105, will be a welcome aural relief from internally installed piston engines; and, of course, the use of kerosine fuel implies the reduced fire risk common to most turbine aircraft.

Here, then, is a helicopter which proclaims formidable improvements in economy, engineering simplicity, quietness, convenience and safety. Such ideals are not easily attained, and it is not surprising that development so far has occupied nearly five years of sustained effort by both airframe and engine teams. There is more work to be done before this promising experiment can be fully translated into operational reality, but the fact remains that the preliminary interpretation of the philosophy, in the shape

Left, the Oryx engine installation (port side) showing the primary compressor air intake. Centre, the spill valve, with the butterfly in the open position. Right, the tilting rotorhead mounted on the tower in the test-pit at Luton, clearly showing the flexible steel duct.



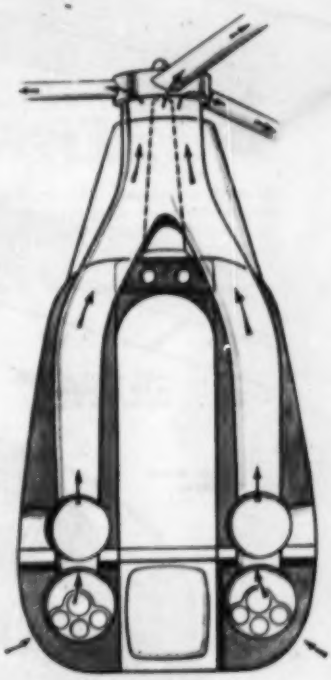
of the P.74, has reached the threshold of its flying trials. The basic problems have been mastered, many of them of an entirely unfamiliar nature.

First, the engine installation. Two engines were deemed desirable, each on one side of the aircraft, feeding, *via* its own "trouser-leg," a common duct to the rotor. When the engines are running steadily, on their "operating line," turbine power matches the sum of primary and auxiliary compressor power; r.p.m. of the turbine and of both compressors are matched; and the auxiliary compressor delivers air at the same pressure as the turbine exhaust which it joins. The delivery flow itself has to satisfy the requirements of the rotor system, performance of which is sensitive to mass flow, tip nozzle area, pressure, and temperature—the upper limit of which is fixed by the mechanical properties of the rotor. Likewise, the ducting from each engine to the rotor head is a most critical part of the system, requiring careful reconciliation between the opposing interests of thermodynamics and engine installation design. Ideally, ducting should be as direct as possible; but the Hunting Percival design aim is to make engines and rotor a compact, individual entity, independent of airframe. We see the expression of this in the P.105, whose rotor/engine group, consisting of an Oryx at each end of a short stub wing just beneath the rotor, can be used in a variety of ways—as an aerial crane, for example. But the development of the ideal engine-to-rotor ducting system, involving lengthy experiment with suitable duct shapes and cascading, is still in progress, and it was clearly desirable to test the principle of the system, using relatively direct ducting, in the quickest possible time. Hence the P.74, whose engines are in the belly of the fuselage, delivering their gas to the rotor by way of trouser legs up the inside walls of the fuselage.

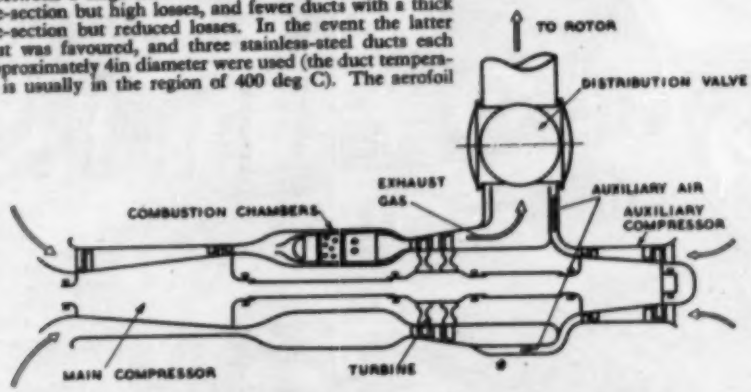
But whilst design of the engine installation and the delivery ducting is critical, design of the rotor is decisive. In compromising between the requirements of aerodynamic efficiency on the one hand and best possible rotor duct flow on the other, the designer faces numerous difficulties. It was decided in the case of the P.74 to use circular ducts, and an attempt was made to arrive at an optimum design within this limitation. Total duct area was determined by mass-flow output from the engines, and the choice lay between a large number of small ducts giving a thin blade-section but high losses, and fewer ducts with a thick blade-section but reduced losses. In the event the latter layout was favoured, and three stainless-steel ducts each of approximately 4in diameter were used (the duct temperature is usually in the region of 400 deg C). The aerofoil

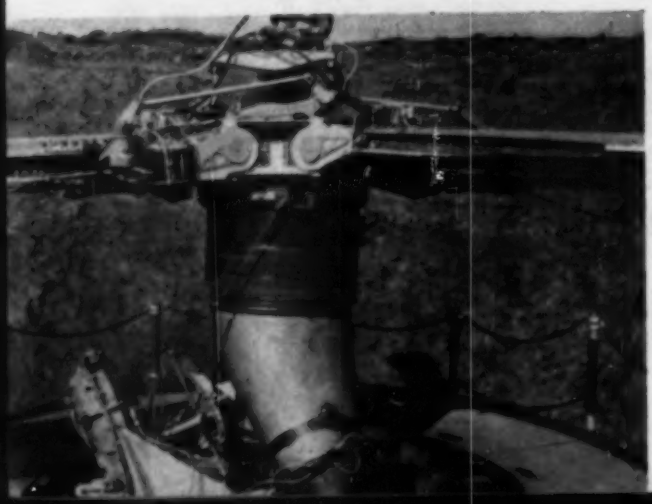
(Above) The Hunting Percival P.74, minus its rotor, had its first outing for engine runs on December 2nd.

(Right) Cross-section of the gas power drive system.

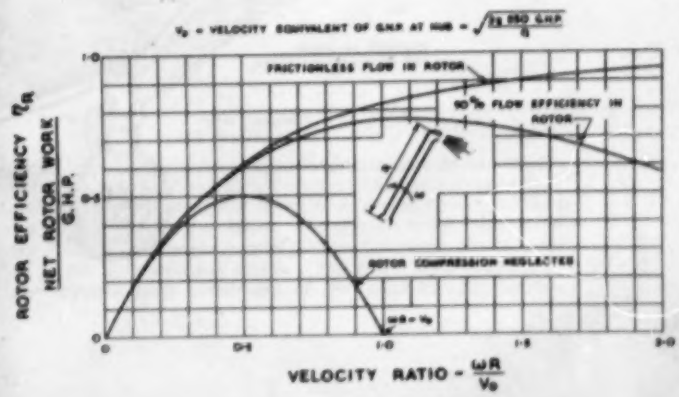


(Below) A diagrammatic view of the Napier Oryx gas generator.



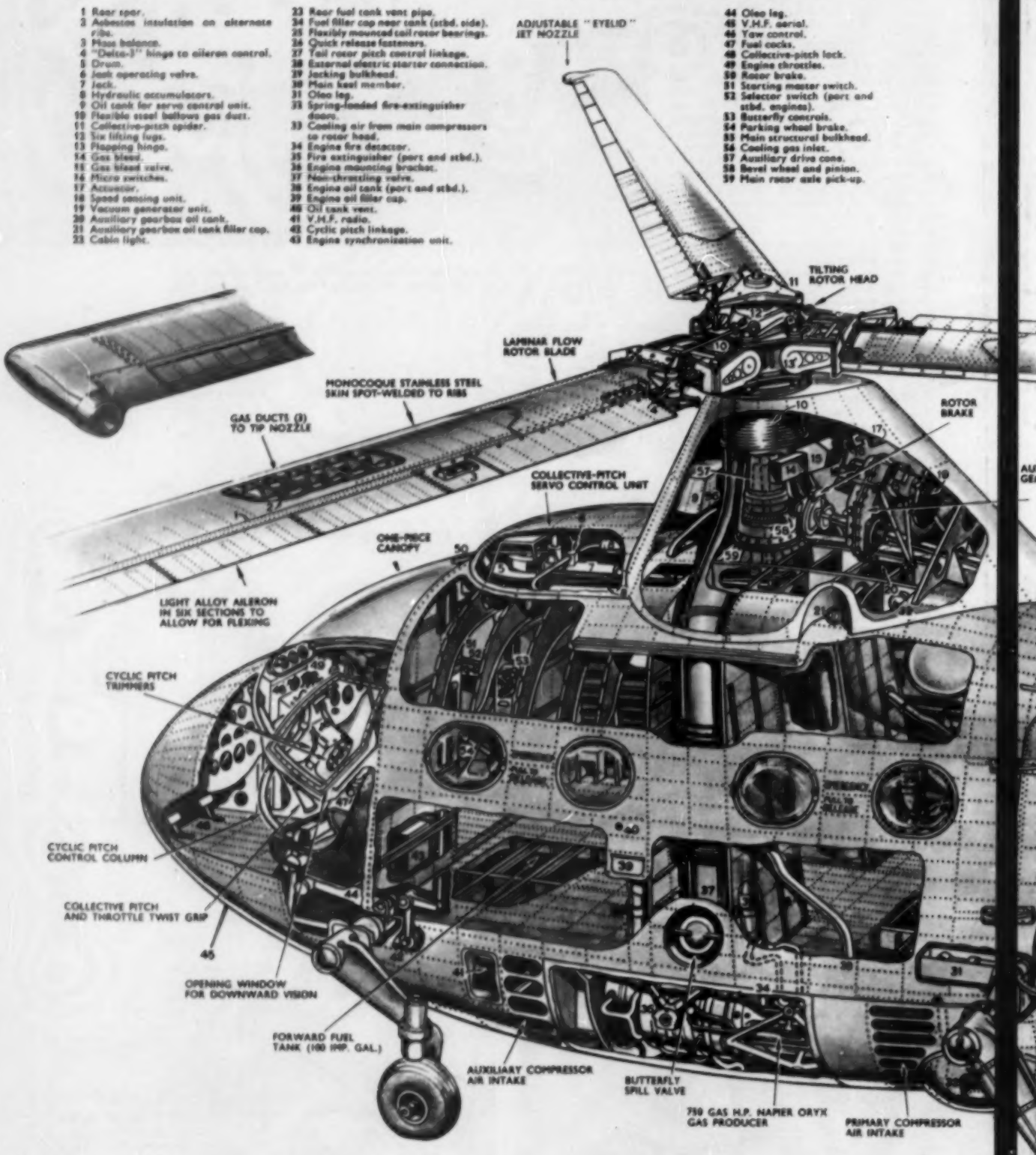


(Below) Variation of rotor efficiency with rotor tip-speed.



HUNTING PERCIVAL P.74 HELICOPTER . . .

1 Rear spar.
2 Asbestos insulation on alternate ribs.
3 Mass balance.
4 "Delco-3" hinge to aileron control.
5 Drum.
6 Jack operating valve.
7 Jack.
8 Hydraulic accumulators.
9 Oil tank for servo control unit.
10 Flexible steel bellows gas duct.
11 Collective-pitch spider.
12 Six lifting lugs.
13 Flapping hinge.
14 Gas bleed.
15 Gas bleed valve.
16 Micro switches.
17 Actuator.
18 Speed sensing unit.
19 Vacuum generator unit.
20 Auxiliary gearbox oil tank.
21 Auxiliary gearbox oil tank filler cap.
22 Cabin light.
23 Rear fuel tank vent pipe.
24 Fuel filler cap near tank (stbd. side).
25 Flexibly mounted tail rotor bearings.
26 Quick release fasteners.
27 Tail rotor pitch control linkage.
28 External electric starter connection.
29 Jacking bulkhead.
30 Main keel member.
31 Oleo leg.
33 Spring-loaded fire-extinguisher doors.
33 Cooling air from main compressors to rotor head.
34 Engine fire detector.
35 Fire extinguisher (port and stbd.).
36 Engine mounting bracket.
37 Non-throttling valve.
38 Engine oil tank (port and stbd.).
39 Engine oil filler cap.
40 Oil tank vent.
41 V.H.F. radio.
42 Cyclic pitch linkage.
43 Engine synchronization unit.
44 Oleo leg.
45 V.H.F. aerial.
46 Yaw control.
47 Fuel cocks.
48 Collective-pitch lock.
49 Engine throttles.
50 Rotor brake.
51 Starting master switch.
52 Selector switch (port and stbd. engines).
53 Butterfly controls.
54 Parking wheel brake.
55 Main structural bulkhead.
56 Cooling gas inlet.
57 Auxiliary drive cone.
58 Bevel wheel and pinion.
59 Main rotor axle pick-up.


ADJUSTABLE "EYELID" JET NOZZLE
TILTING ROTOR HEAD
LAMINAR FLOW ROTOR BLADE
MONOCOQUE STAINLESS STEEL SKIN SPOT-WELDED TO RIBS
GAS DUCTS (2) TO TIP NOZZLE
ROTOR BRAKE
COLLECTIVE-PITCH SERVO CONTROL UNIT
ONE-PIECE CANOPY
LIGHT ALLOY AILERON IN SIX SECTIONS TO ALLOW FOR FLEXING
CYCLIC PITCH TRIMMERS
CYCLIC PITCH CONTROL COLUMN
COLLECTIVE PITCH AND THROTTLE TWIST GRIP
OPENING WINDOW FOR DOWNWARD VISION
FORWARD FUEL TANK (100 IMP. GAL.)
AUXILIARY COMPRESSOR AIR INTAKE
BUTTERFLY SPILL VALVE
750 GAS H.P. NAPIER ORYX GAS PRODUCER
PRIMARY COMPRESSOR AIR INTAKE

enclosing them, although necessarily of thick section—22.5 per cent—was designed to have zero-incidence laminar-flow characteristics up to about mid-chord. The blades are non-feathering, and variation of incidence is taken care of by ailerons, which are in six 3ft sections to compensate for blade-flexing, each attached by three hinges of Ferobestos plastic (no lubrication is necessary) to a C-section "tape"; centrifugal force on the blade tends to keep the aileron in the up position, and downward movement is accomplished by a cable attached via a linkage to a classical type of rotor head pitch-control. (Collective pitch is achieved in the usual way by means of a vertical screwjack.) The arrangement is not as complicated as it sounds, and has worked well on the test-rig. When the thermodynamic and manufacturing problems of flattened ducts have been solved a better aerofoil section will result, eliminating the need for ailerons. This is one respect in which the P.105, with its feathering blades, will be an improvement on the P.74.

The blade itself is a pure monocoque of stainless steel, with 22-gauge skin averaging 130 deg C at the root. (Blade de-icing will obviously not be a problem.) Flow at the end of each duct is carefully cascaded through 90 deg into a single discharge nozzle which, as will be explained, has a two-position "eyelid" to vary nozzle area.

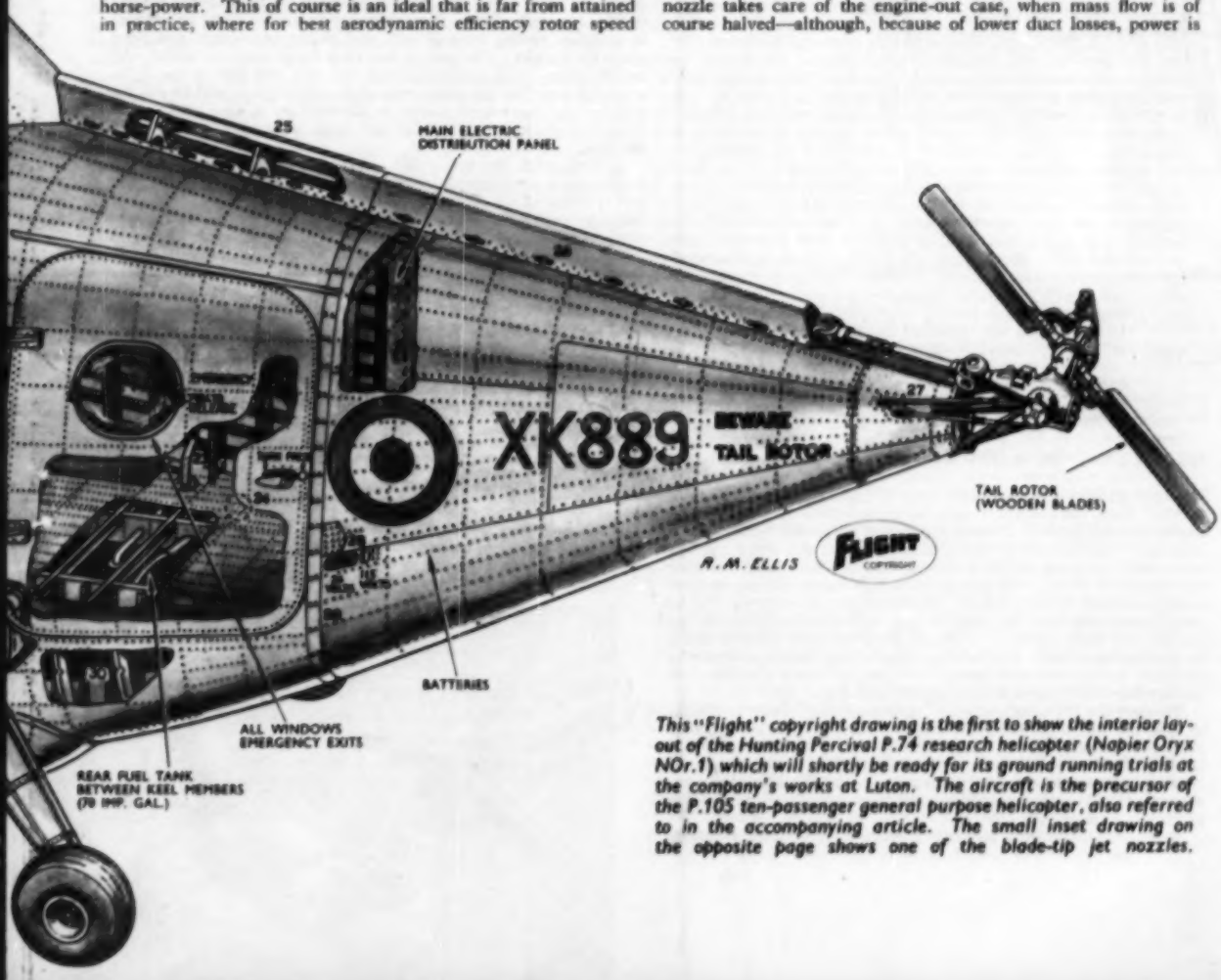
The tilting rotor hub is a fabricated steel structure mounted on Timken taper-roller bearings to permit hub-tilt, this unit in turn being mounted on a spherical bearing. Below this is a flexible gas-tight bellows duct of stainless steel, designed to withstand the complex motion of bending and shearing. A small accessory gearbox is driven off the rotor, from which the rudder rotor takes its drive, and the whole is neatly encased in the rotor hub fairing. A conventional type of friction rotor brake is fitted. Similar flexible ducts, passing between the blade flapping hinges, convey the gas flow into the rotor ducts. The flapping hinges have plastic bearings requiring no lubrication.

It is evident that the centrifugal action of the rotor further compresses the flow, increasing the velocity of the jet, which would theoretically go on increasing until the limiting speed of the rotor was reached. Duct losses obviously preclude this, but it is academically interesting to note that (since rotor horse-power increases with rotor speed) at infinite rotor speed gas horse-power delivered by the engines would be converted entirely into lifting horse-power. This of course is an ideal that is far from attained in practice, where for best aerodynamic efficiency rotor speed should be kept low (P.74 maximum tip Mach number is 0.55). In reality the ratio of rotor horse-power to gas horse-power is of the order of 0.5. The set of curves on page 939 shows the variation of this ratio with velocity for three conditions: frictionless flow; 90 per cent flow efficiency; and without centrifugal compression.

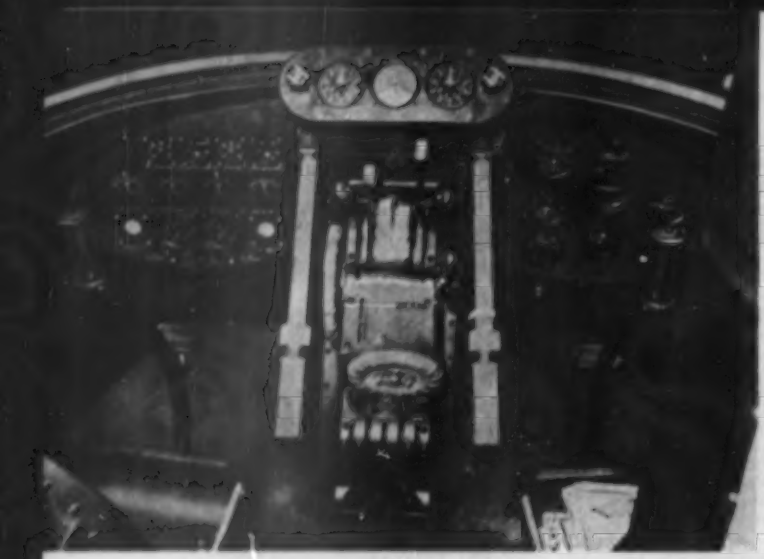
The optimum conditions for best rotor performance have been the subject of prolonged investigation on the Hunting Percival test tower at Luton. As can be seen in the photograph, this was sunk below ground level, for reasons of silence and safety. In general layout the pit is reminiscent of a Roman arena, with its stepped sides and underground entrance passage. A Derwent is used to provide power, its exhaust being cooled to the requisite temperature by water. The installation first ran last March, and the programme of testing the P.74 system has now accounted for some 40 hours of running. This may not seem a great deal on first consideration, yet the amount of data it has yielded is apparent from a typical recent programme in which 40 sets of aerodynamic measurements were taken in a test which, although occupying five days (including a week-end), yielded only 4½ hours of rotor running.

The fact that the two engines of the P.74 deliver gas into a common duct and nozzle means that special care has to be taken to ensure that each engine is running on its "operating line." It was assumed in the early stages of design that the engines would be particularly sensitive to back-pressure, and a comprehensive automatic control system has been developed by Napiers to guard against the likelihood—for example—of the following sequence of events taking place: one engine, its output momentarily falling behind that of its partner, is caused to surge and stall by back-pressure; its partner, working against suddenly reduced back-pressure, simultaneously overspeeds. Napier test work has shown that in actual practice a pair of Oryxes delivering into a common duct and nozzle are not so sensitive to one another as had been at first supposed; but only running tests with the complete P.74 will show how compatible they are. All this, incidentally, will be no problem with the P.105, in which each engine feeds its own duct and nozzle.

The P.74 engine control system is a most interesting piece of engineering, and is the subject of a diagram included in our summary (pages 933-934) of a paper read before the Helicopter Association by Mr. A. W. Morley of Napiers. The two-position nozzle takes care of the engine-out case, when mass flow is of course halved—although, because of lower duct losses, power is

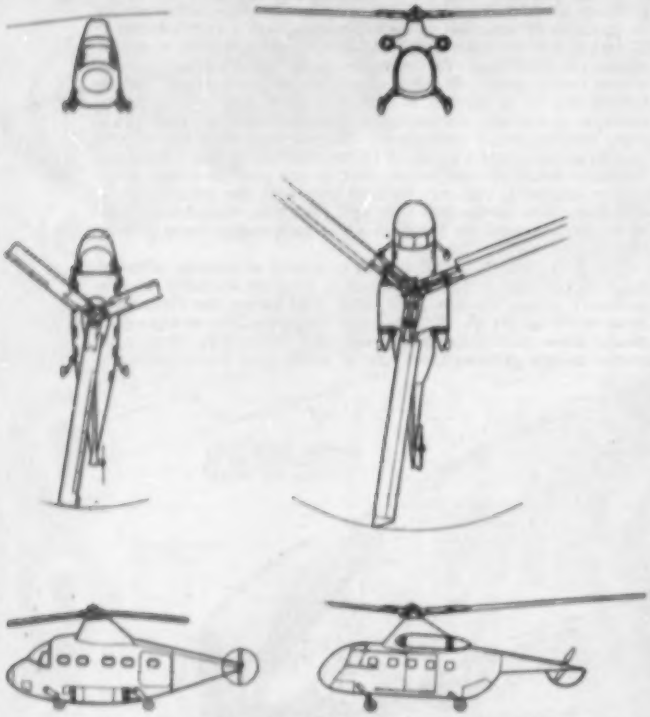


This "Flight" copyright drawing is the first to show the interior layout of the Hunting Percival P.74 research helicopter (Napier Oryx NOr.1) which will shortly be ready for its ground running trials at the company's works at Luton. The aircraft is the precursor of the P.105 ten-passenger general purpose helicopter, also referred to in the accompanying article. The small inset drawing on the opposite page shows one of the blade-tip jet nozzles.



The P.74's cockpit closely follows classical helicopter practice. Of special interest are the engine-synchronizer indicator at the top, and the levers at the foot of the pedestal which select transfer of engine gas output either to the rotor or to spill overboard.

(Right) The neat undercarriage, which consists of a single light-alloy leg with the shock-absorber inside the fuselage.



General arrangements, approximately to scale, of the P.74 research helicopter, and (right) the P.105 ten-passenger commercial vehicle.

HUNTING PERCIVAL P.74 . . .

less than halved. If an engine fails in flight it is automatically isolated from the common duct to prevent flow from the good engine passing into it. This is accomplished by the hydraulically operated "non-throttling" valve at the start of the duct. At the same time the rotor nozzle is moved into its part-closed position by means of a mechanical linkage from this valve, this mechanism being designed to "fail open." Theoretically, to keep the engine on its operating line the area of the rotor tip nozzle should be varied with rotor r.p.m. To avoid this a blow-off valve is fitted in the common duct; this valve is sensitive to rotor speed, and is operated by a governor driven by the accessory gearbox. A similar blow-off system will be included in the P.105.

To start the P.74, each engine "non-throttling" valve is closed, to spill the whole gas output overboard *via* a duct in the fuselage side. A butterfly valve, flush with the skin, allows for varied loading of the engine. Each engine may then be brought up to its correct speed and delivery pressure, at which point the non-throttling valves are smoothly opened to transfer flow, one engine at a time, to the rotor.

Structurally, the P.74 airframe is quite conventional, although it embodies a number of new ideas. The sturdy four-wheel undercarriage, for example, is the neatest helicopter chassis we have seen. The usual angular struttery carrying each wheel is replaced by a single swinging link, a substantial magnesium alloy casting, the shock-absorber of which is mounted within the fuselage. Wheels are fully castering, and the rear pair are fitted with Palmer pneumatic brakes. Tyre pressures are 80 lb/sq in. All the cabin windows, four on each side, are escape hatches, alternately openable from inside and outside.

Construction of the fuselage conforms with accepted helicopter practice in that it may be likened structurally, and without disrespect, to the shopping basket: lifting loads are carried into the fuselage container by sturdy bulkheads ("handles") and are taken out by the skin and into the keel by shear members. Undercarriage landing loads are taken by stiff frames reacted down into the keel web structure. The door is of a useful size (4½ft by 5ft) and here it is appropriate to mention that, although the P.74 is purely a test vehicle for proving the new propulsion system, its designers have taken the trouble to make its commercial potentialities apparent. There is ample room aboard for eight passengers in addition to the crew of two, and plenty of volume and floor space for freight. The cockpit has dual flying controls, which will enable pilots to be easily initiated into the new feel of the P.74; a glazed nose has not been provided—although it will be on the P.105—and downward vision is afforded by large D.V. panels. Two fuel tanks, of 170 Imp. gal total capacity, are housed in the keel.

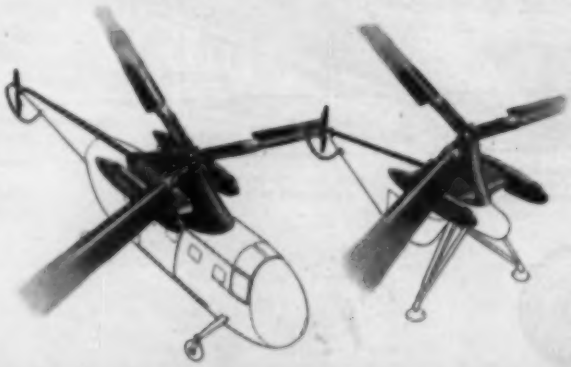
Design work on the P.105, which, as previously mentioned represents a considerable refinement of the P.74, is in hand, and construction of the prototype rotor has started. This ten-passenger machine will be the first commercial interpretation of the new propulsion system. It may be expected to make its debut in 1958, by which time a great deal of pioneering experience will have been gained from the P.74. Of its promised merits—economy, quietness, simplicity, flexibility—the latter stands out most prominently. Since the essence of a helicopter is its rotor/engine combination, the availability of a compact and independent unit, to which almost any kind of frame may be fitted, promises a significant broadening of the scope of future helicopter operations.

LEADING DATA

P.74 Research Helicopter (two Napier Oryx NOr.1 turbines of 750 g.h.p.)—Maximum weight, 7,750 lb; fuel capacity, 170 Imp. gal; rotor diameter, 55 ft.

P.105 General Purpose Helicopter (two Napier Oryx NOr.4 turbines of 925 g.h.p.)—Maximum weight, 10,000 lb; seating capacity, two pilots and ten passengers; fuel capacity, 230 Imp. gal; cruising speed, 100 m.p.h.; vertical rate of climb at loaded weight of 9,600 lb, 2000ft/min; range with full payload of 3,250 lb, 145 miles at 5,000ft; rotor diameter, 63ft.

The ultimate aim of the Hunting Percival helicopter design philosophy is a compact and independent rotor-engine system which permits complete freedom of choice of the airframe. On the left is the ten-passenger P.105, and on the right the "aerial crane."



Twenty-one Years of Flight Refuelling

A HISTORY of Flight Refuelling, Ltd., is a success story in the truest sense of the word. What began as a casual experiment or a publicity stunt was taken up by Sir Alan Cobham and developed into a technique, and a range of equipment, which makes available to all those who have the vision to use it the full potential offered by in-flight refuelling. In 21 years of work, Sir Alan and his many associates and workers have reached the point where the air forces and naval air services of two of the world's largest air arms have placed, or are likely to place, extensive orders for the latest versions of his products. But equally significant with the process of development is the fact that, in this year of success, the company has the industrial capacity to produce the equipment which has been ordered from it. Flight Refuelling has available a group of technicians and an extensive background of commercial activity which, even without the much sought-after probe and drogue equipment, would assure the company a worthy place in the British aircraft industry.

In fact, Flight Refuelling, Ltd., in England—there are three more companies producing the firm's equipment abroad—consists of four major sub-divisions. The first (but not at the moment the largest) is engaged in developing and producing the probe and drogue equipment now destined for the V-bombers and other British Service types. The second division originally sprang from the first, since air refuelling required a series of automatic shut-off valves, float switches, and other similar equipment, which the company designed and perfected on its own account. When, in 1950-51, pressure-refuelling from bowsers became mandatory, because of the large quantities of fuel which had to be shifted after each landing, the company already had available the wide range of equipment needed for this type of work, and it therefore soon achieved the status of consultant to the industry on fuel systems. The second division, therefore, is in full production with a wide range of equipment for practically every modern British aircraft. In addition, the Canadian subsidiary, Flight Refuelling (Canada) Ltd., of Toronto, and the French licensee, Carburateur Zenith, are also in full production with this type of equipment. It is, in fact, often the case that the company are called in in the early design stages to assist in the preparation of a new aircraft's fuel system.

The third division, which occupies a large part of the airfield facilities at Tarrant Rushton, the company's present main base, deals with the major overhaul, retrospective modification, and Category 4 repairs of military aircraft—at present mostly Meteors. In the past, Brigands, Lancasters and Vampires have been similarly dealt with.

Finally, a fourth division of the company has been engaged for the last 15 years on a variety of M.o.S. development contracts dealing with almost anything, from the towing of fighters during World War 2, through the development of thermal de-icing equipment, to the establishment of metal strength standards. For this purpose a complete design office and test laboratories are available, but little can be said of their work, since so much of it is, of course, covered by security. Not content with this, the company has also engaged in manufacture of aircraft components under sub-contract, and, having just completed a large batch of Sea Hawk after-fuselages for Armstrong Whitworth Aircraft, Ltd., has now begun on the production of external fuel tanks for Vickers Supermarine.

Some of the men behind the ideas, Michael Cobham, director (commercial), Sir Alan Cobham, chairman and managing director, C. Tonge, director (finance) and H. C. Harrison, director (engineering).

The probe and drogue system, the most flexible and compact of the company's developments and the one which has been extensively adopted by the U.S.A.F., the U.S. Navy and the R.A.F.

The company has even moved outside the aircraft field to produce equipment for the latest armoured fighting vehicles, and for fast marine craft, such as high-speed gas-turbine-driven patrol boats. Agents and representatives are located at points all over the world, and the company's equipment has been employed in such a variety of aircraft as the French S.N.C.A.S.E. Barcoudeur and Caravelle, the S.N.C.A.S.O. Vautour, on certain Avro Canada aircraft, in the Finnish Valmet Vihuri, the Fokker Friendship and Dutch- and Belgian-built Hunters, the Swiss P-16 fighter, Italian Aerfer types, and the Australian Jindivik pilotless aircraft. It is also a little-known fact that, some five years ago, the Argentine Government was very seriously interested in fitting up a number of Lancaster tankers to refuel Meteor fighters. This scheme was unfortunately abandoned before it came to fruition. More recently, however, South America has again figured in Flight Refuelling affairs with the supply of certain ground equipment for refuelling the Hunter 4s ordered by the Peruvian Air Force.

It was in 1932 that Sir Alan Cobham became seriously interested in flight refuelling, the object being to achieve a form of assisted take-off. In earlier years as his trusty D.H.9, overladen with fuel, ground its way towards the far hedge without any signs of becoming airborne, Sir Alan had wished fervently for something which would help him to avoid such unpleasant moments. His solution was to take-off with a light fuel load and to receive the majority of his fuel in the air at a time when the aircraft could comfortably fly at a weight much greater than that at which it could get itself airborne.

Sir Alan's work, however, was not the first in the field of flight refuelling, since the U.S. Army Air Corps had, in 1923, tried a quite crude form of air refuelling with some success and, using it as a means of staying airborne, had made a flight of 37 hr 15 min. The French had also tried it in the same year, but interest had lapsed until 1929, when the U.S. Air Corps achieved an endurance of 150 hours with the Fokker tri-motor "Question Mark." Then the business caught on as a stunt and many flights were made in America, culminating in the staggering endurance of 647½ hours by Jackson and O'Brine in a monoplane called *Greater St. Louis*. In 1930 S/L. (later A-V.M.) Atcherley visited the United States to take part in the National Air Races. He saw some of this stunt work in progress, and returned to his squadron with the idea of developing the technique and improving equipment. Later he devised a system where the receiver aircraft trailed a long line astern, and the tanker, trailing a shorter line, passed behind it so that the two lines crossed and became united by grapnels at their ends. With the two aircraft formating, a hose was then drawn across from the tanker and fuel passed.

The Harrow tanker and the Empire flying boat refuel over the Solent before the start of the first trans-Atlantic air-refuelled service in 1939.

The B-29 three-pointer refuelling the probe-equipped B-29.

FLIGHT REFUELLING . . .

Sir Alan Cobham entered the lists officially in 1932, and, after some experiments with two D.H.9s, he embarked on a non-stop England-to-India flight with the prototype Airspeed Courier refuelled by a Handley Page W.10 over Malta and a R.A.F. Victoria and Valencia at other points. The assisted take-off principle was initially employed and the Courier was for the first time cleared for a take-off weight of 3,700 lb and for flight at 5,050 lb. Sir Alan took off with S/L. Helmore and immediately received his overload and headed for Malta, where W/C. Johnson was waiting for him with the W.10. They duly made contact and fuel was passed on track outward bound from Malta. When the Courier's load was almost at its maximum level, however, a pin in the throttle linkage fell out, and Sir Alan was obliged to make an almost power-less wheels-up forced landing at Hal Far. He just made it. The attempt had then to be abandoned, and after selling the W.10, "Johnnie" Johnson brought the Courier back to England.

The method of making contact between the two aircraft was that the tanker lowered a weighted line to the operator in the receiver while the two aircraft flew one above the other. The line was then used to haul in the hose and fuel transfer was by gravity. The first weight used was a paint tin filled with lead shot, and the crooked end of a walking stick was employed to catch it. But one day the paint tin fouled the Courier's ailerons and very nearly brought disaster; and recourse was thereafter made to a variety of frangible rubber water-containers which could be caught by hand. If these fouled the aircraft, they immediately burst, causing no damage.

The company called Flight Refuelling, Ltd., was formed in 1934, and Sir Alan began serious development of more advanced refuelling techniques and associated equipment, including the predecessors of the automatic shut-off valves which are now produced for air and ground pressure-refuelling purposes. Imperial Airways became interested, and the Shell company backed Sir Alan. Various experiments were carried out with Vickers Virginia tankers and Wapiti receivers, and Wallace tankers and Hart receivers. The system was demonstrated at the R.A.F. Display.

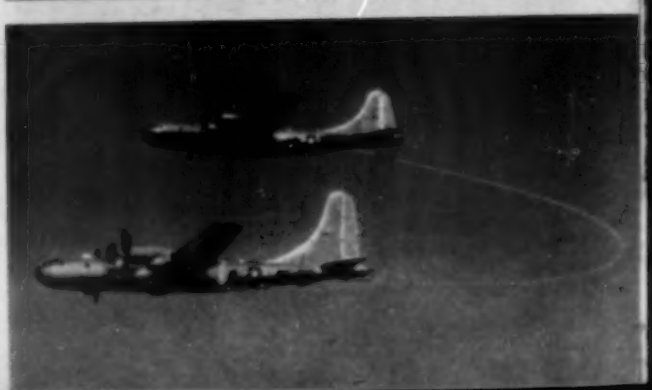
Meanwhile, Flight Refuelling, Ltd., moved to Ford, Sussex, in 1936, and continued experiments with a variety of military aircraft. But the first practical expression of the commercial philosophy behind the air refuelling concept was the transatlantic flying boat service run by Imperial Airways and projected in 1937. No boat existed which could carry a reasonable payload with safety non-stop across the Atlantic, and of the three methods —catapulting, pick-a-back take-off, and air refuelling—which were projected, the last-named was put into practice in the form of a scheduled service. First experiments were made with the C-class boat, *Cambria*, refuelled by an A.W.23, using what came to be known as the loop hose system. This now consisted of a special grapnel trailed on a long line by the receiver, which was engaged by another grapnel fired on another line from a special gun by the tanker. The hose was then wound in by a winch and automatically connected. Fuel was passed by gravity while the tanker flew above and to one side of the receiver.

Development continued through 1938 and two boats, *Cabot* and *Caribou*, were converted on the production line. The plan was to land and refuel at Foynes, near Shannon, take-off again and accept a fuel overload from a Harrow tanker based at Shannon. Course was set for Newfoundland and one of two other Harrow tankers based at Gander and Goose passed more fuel to allow the boat to continue to Botwood, where it landed again, refuelled, and finished the journey to New York.

On August 5th, 1939, *Caribou*, piloted by Captain Kelly Rogers, took on 1,000 gallons in 16 minutes shortly after leaving Foynes, and continued with another refuelling to Botwood. Altogether, 16 crossings were made, and with a rate of flow of just over 100 gal/min, refuelling took less than eight minutes each time, with five minutes spent making contact. On only one flight was the aircraft not refuelled, and then because an exceptional tail-wind on a west-east crossing allowed the direct flight to Shannon. Normally, the boats were only refuelled once in this direction.

World War 2, of course, interrupted these activities, and Flight Refuelling, Ltd., anticipated the destruction of their base at Ford by moving to Malvern, where they carried out a wide variety of research for the Ministry of Aircraft Production. This included the development of thermal de-icing and of methods of towing fighters as a means of getting them to Malta.

When the United States entered the war in 1941, the U.S.A.A.F. issued a requirement for a long-range bombing mission, and Flight Refuelling were called in to facilitate its achievement. Mr. P. R. Allison, now the company's service manager, was sent across to work on a B-17 and a B-24. He decided to use the latter as the tanker, and a loop hose installa-



The North Atlantic service with a Liberator and the Lucky Lady's round-the-world flight (above right and right) used the loop-hose system.

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Final development of the probe and drogue system was begun with the self-contained pack in a Canberra and a Meteor. They could dispense with the grapnels (right) used with the earlier loop-hose.

FLIGHT REFUELLING . . .

tion was produced for the two aircraft. It is typical of Flight Refuelling methods and personnel that Mr. Allison devised on the spot an improvement of the system to allow the use of auxiliary power to ease the operator's task. The U.S.A.A.F., however, did not continue with the system, and the company went on with its other research work.

Quite suddenly, in 1944, the Air Ministry descended on the company and ordered them immediately to modify 600 Lancasters as tankers and 600 Lincolns as receivers in order to allow Tiger Force to bomb Japan from South-East Asia. Tremendous effort was expended to finalize installations and produce equipment, and St. Athan and another airfield were taken over, and soon filled to capacity with aircraft awaiting conversion and equipment production lines. Then the Americans offered the R.A.F. an island within the Lincoln's unrefuelled striking range of Japan, the Hiroshima bomb was dropped and, with equal suddenness, the whole Tiger Force contract was cancelled. It can be imagined what effect these events must have had on the company, but it is typical that their initial reactions were fast and that they took the tremendous "accelerate—stop" more or less in their stride. However, the end of the war left them, to some degree, in the air.

The Tiger Force project, though abortive, was a considerable step toward official recognition of the value of flight refuelling, and after the war the Ministry of Civil Aviation was not slow to make use of the equipment and facilities which remained from the wartime venture. Flight Refuelling Ltd., moved back to Ford, and the Ministry placed a contract for a series of air-refuelling operations using British South American Airways aircraft as receivers. The scheme was that tankers would stand by at Ford, and that at any time B.S.A.A. at Croydon would notify them that a refuelling was required at a given point over the Channel or northern France at a certain time and height. F.R. would then arrange for the tanker to take off and make the rendezvous and pass 1,000 gallons of fuel with the loop hose system. B.S.A.A. carried a Flight Refuelling operator to work the equipment but there was, otherwise, practically no liaison between the two airfields and B.S.A.A. crews were not specially trained. In fact, the dates and times of refuellings had been decided three months beforehand, and only the place was fixed on the day of the operation. B.S.A.A.'s converted Lancasters were ostensibly on crew training flights. Contact between the two aircraft near the rendezvous was established with the aid of Rebecca radar beacons, and it was Flight Refuelling who modified and developed the equipment themselves for this special application.

These trial contacts established that refuelling could be carried out almost regardless of weather and without elaborate training of airline personnel, and it was therefore decided that in 1947 a non-stop scheduled London-to-Bermuda service should be flown with B.S.A.A. converted Lancasters being refuelled over the sea north of the Azores by F.R. Lancasters. In all, 22 flights were made, and of these only one was not completed, and that because the receiver suffered engine failure and landed in the Azores. F.R.'s base was at Santa Maria, and again, a notification of the airliner's departure would be received and a rendezvous point decided upon. The tanker then took off, made contact first on V.H.F., then with Rebecca and finally visually, and fuel was passed without receiver deviating from its planned track at all for the purpose. The receiver generally passed within 200 miles of the tanker's base; but on the second eastbound flight Capt. R. C. Alabaster flew a rhumb line course, passing more than 500 miles north of the Azores, and with refuelling was able to set up a record time for the journey of 13 hr 59 min.

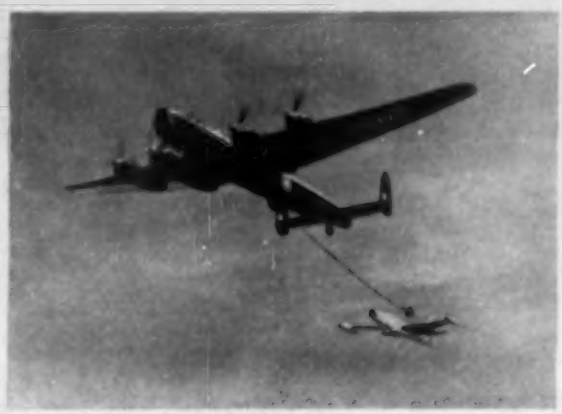
Close-up and thirsty is the Meteor 3 during its 12-hour flight to prove probe and drogue. The pilot was Pat Hornidge.

The final test for Flight Refuelling was the North Atlantic operation which was carried out in the worst weather period of the year, and, incidentally, at a time when the cloud might often extend to a height of above the aircraft's ceiling. B.O.A.C. modified one Liberator 2 as a loop-hose receiver, and Flight Refuelling bought four of T.C.A.'s Lancastrians and based them at Shannon, Gander and Goose. The westbound crossing was to have two refuellings, and the eastbound flight one (from Gander or Goose). Despite weather and wind, 15 return flights were made between February and May of 1948, with contact points 500 or 600 miles west of Shannon, and then about 100 miles out from Gander for the westbound flight, and approximately 200 miles out from the Newfoundland coast for the return. In this operation, there were three missed contacts, but none of them was due to the refuelling equipment. On no occasion did a tanker fail to take off.

In none of the transatlantic services did the aircraft carry normal fare-paying passengers, but many observers and technicians and many of Flight Refuelling's own staff made the crossings, quite apart from the fact that the company's pilots flew the tankers. And it should not be forgotten that the Harrow tankers of the pre-war service carried a pilot and two technicians and neither navigator nor radio.

After this, the British authorities took no further positive interest in flight refuelling; but the technique was proved. However, the Americans began to take a real interest in air refuelling in 1947, and it can be said that most of what has been achieved since then was due to the stimulus of American interest, though the enthusiasm and the fine work of the English company was the moving force behind the technical achievements.

One must mention here, however, an interlude which is typical of the company. While their work for the Americans was in progress in July 1948, the Berlin Airlift started, and Sir Alan suggested that Flight Refuelling was admirably equipped to carry fuel to blockaded Berlin. Within 24 hours of the order being received, and at a time when the company had just moved to Tarrant Rushton and the tankers were just back from Gander, the Lancastrians already equipped as tankers started to operate from Bückeburg into Gatow. They soon moved to Wunstorf, and



(Left) Two Meteor 8s of No. 245 Squadron, and a Meteor 4 operated by Flight Refuelling, Ltd., prepare to contact the U.S.A.F.'s B-29 "three-point" tanker over England. (Right) A U.S.A.F. F-84 refuels from one of the company's Lincolns.

FLIGHT REFUELLING . . .

then to Hamburg, but by the time, many months later, that the operation was completed, Flight Refuelling had over 42 crews, and were flying 38 sorties per day with loads of 2,400 or 2,500 gal. Turn-round times were about 20 minutes. Towards the end of the air lift, so much fuel was being brought in that some of the tankers were made to carry diesel oil.

During this time, the American Air Force sent a B-29 to Tarrant Rushton to be converted as a loop hose tanker, and there soon followed an order for a hundred B-29 receivers and 60 B-29 tankers. The equipment was installed in America.

In February 1949, the U.S.A.F. was embroiled with the U.S. Navy on the subject of range and the usefulness of the large aircraft carrier. It was therefore given to the 43rd Air Refuelling Squadron to achieve an air-refuelled non-stop round-the-world flight, for which B-50s were specially converted as receivers. Accordingly, the second *Lucky Lady* set off from Carswell A.F.B., Texas, on February 26th, 1949, and landed there again on March 2nd, having been refuelled over the Azores (3,800 miles), Dhahran (5,200 miles), the Philippines (4,900 miles), and Hawaii (5,300 miles). Total flight time was 94 hr 1 min and the total distance flown 23,108 miles. Four tankers were based near each refuelling point, two to make the actual transfer and two more as reserves.

Soon after this, Boeing, who did the installation of the loop hose equipment, devised their own flying boom system, which was adopted as standard for both bombers and fighters, and has served the U.S.A.F. up till now.

At the end of 1948, the Americans asked Sir Alan whether he could help them with an air-refuelling system adaptable to single-seat fighters, i.e., a system not requiring a separate operator in the fighter aircraft. Sir Alan was already thinking along these lines, and a very few months later his staff had developed and produced a prototype set of the probe and drogue equipment which must rank as the company's major development in this line. Apart from the idea of the probe and drogue, the true origin of which is shrouded in mystery, a good deal of work was required on the equipment to be incorporated in the receiver's fuel system and, of course, on the complex problems to be overcome in the tanker's hose reel unit. Suffice it to say that many initial problems have been overcome, and that the probe and drogue is now in regular use by the U.S. Navy, has been ordered in quantity for Tactical Air Command of the U.S.A.F., and is being rapidly developed for the R.A.F.'s V-bombers. Other applications are still subject to security.

The latest probe-and-drogue hose-reel pack, tested in a Canberra to refuel Meteors and a prototype Javelin. The skirt of the drogue is perforated to reduce its drag at high airspeeds.

The U.S.A.F. came to see the probe and drogue immediately after it had first been tried, and then sent a B-29 over to Tarrant Rushton to be converted into a three-point tanker with drogue units under the tail and at the wing tips. Another B-29 was fitted with a probe above the pilot's cockpit, and two F-84s were sent over to have probes attached to the wing leading edge. All these aircraft were tested, and on August 7th, 1949, Flight Refuelling's Meteor 3 remained airborne over southern England for 12 hr 3 min, making 10 refuelling contacts with the prototype Lancaster tanker. Rebecca/Eureka was installed but was not needed until the end of the flight, when the weather deteriorated, and the last contact was in fact made as the two aircraft went into cloud. The Meteor's normal oxygen supply sufficed.

In August 1950, the F-84s with probes first flew, and on September 22nd, two Americans, Colonels Schilling and Ritchie, flew across the Atlantic non-stop from Prestwick to Limestone, Maine. Flight Refuelling tankers were standing by for the purpose at Prestwick, and Keflavik, and the B-29 was at Bluie West 1. Colonel Ritchie's probe was damaged in the final contact, and he had to bale out, landed on the American coast, and was picked up by a helicopter. Colonel Schilling completed the flight.

These two flights put probe and drogue well and truly on the map, and it has not looked back since. The American Air Force took it up and probes were fitted in the noses of external tanks of a number of aircraft, and large formations were flown, both across the central Atlantic and the Pacific, and over long distances in South-East Asia.

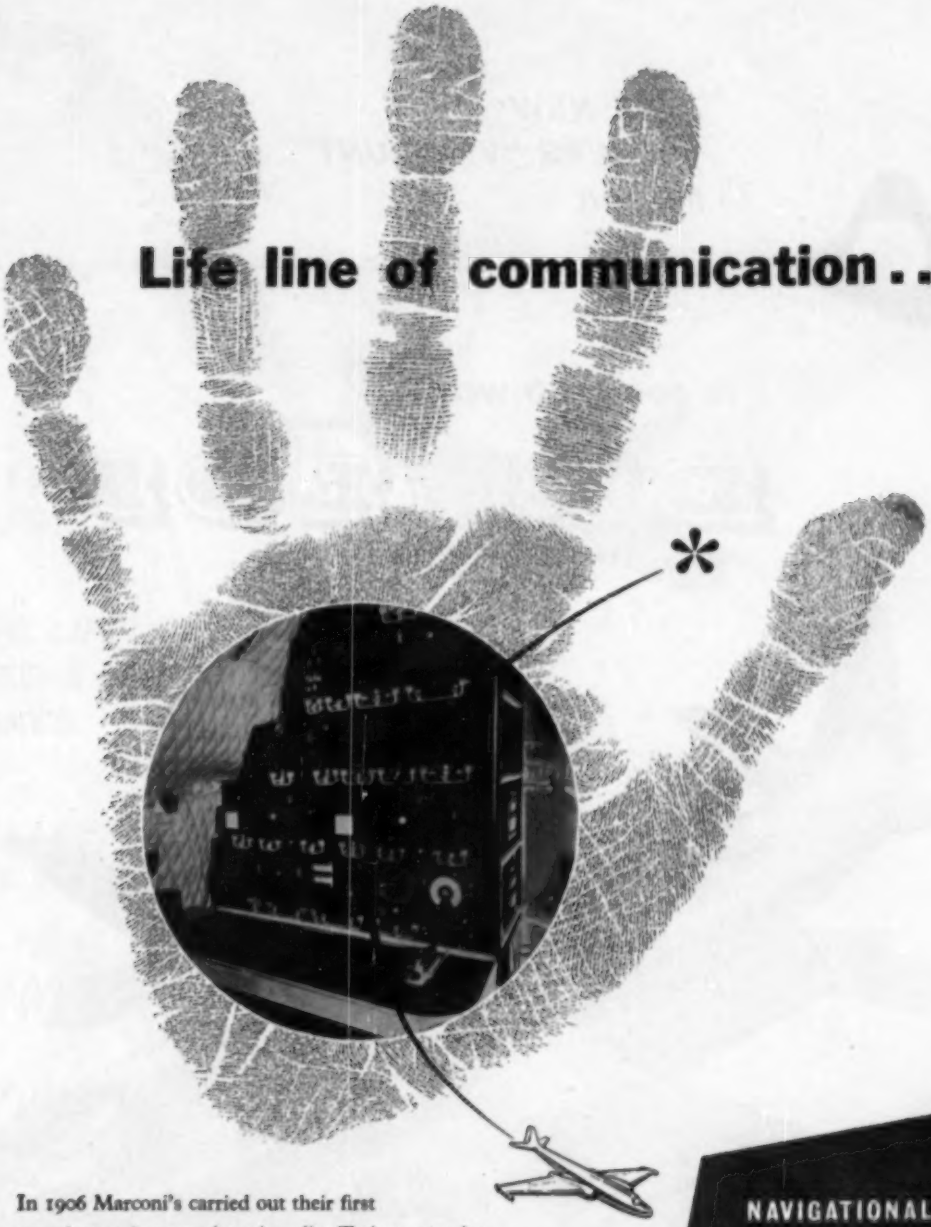
The original three-point tanker played a major part in these flights, and when the Korean conflict started, probe-and-drogue was tried out in battle conditions. Both Sabres and F-84s were tried, one F-84 making six strikes during a 14-hour air-refuelled flight without landing. The Sabres, on the other hand, reverted to Sir Alan's original assisted take-off idea, since Korean strips were too short for full load take-off, and the use of JATO rockets raised an impenetrable dust-cloud. The aircraft took off light, topped up to full load immediately overhead, and went on their way. During this time, also, Strategic Air Command was experimenting with B-47 probe and drogue tankers and receivers, but the system did not replace the flying boom.

By this time the R.A.F., too, became interested, and the Meteor 8s of No. 245 Squadron at Horsham St. Faith were fitted with probes in the nose. Experiments, mostly related with the maintenance of standing patrols, were fitted into the squadron's normal training programme. Thus, when refuelling was required, the station called for tankers from Tarrant Rushton, and six Meteors were kept airborne for three to four hours at a time. The tankers would wait inland, and while one pair patrolled, another pair would be in transit to the tanker, and the third pair would be refuelling. The tanker would land and fill its own tanks before refuelling the third pair. The whole operation worked perfectly, and the Meteor pilots had tremendous confidence in it, even to the point of returning to the tanker without enough fuel to land somewhere if anything went wrong. It was also tried successfully at night, in total darkness and in the moonlight.

The rate of fuel transfer in these operations was about 180 gal/min, but the equipment is still being developed to provide many times that rate of flow. In fact, it has already

(Concluded at foot of page 954)

Life line of communication . . .



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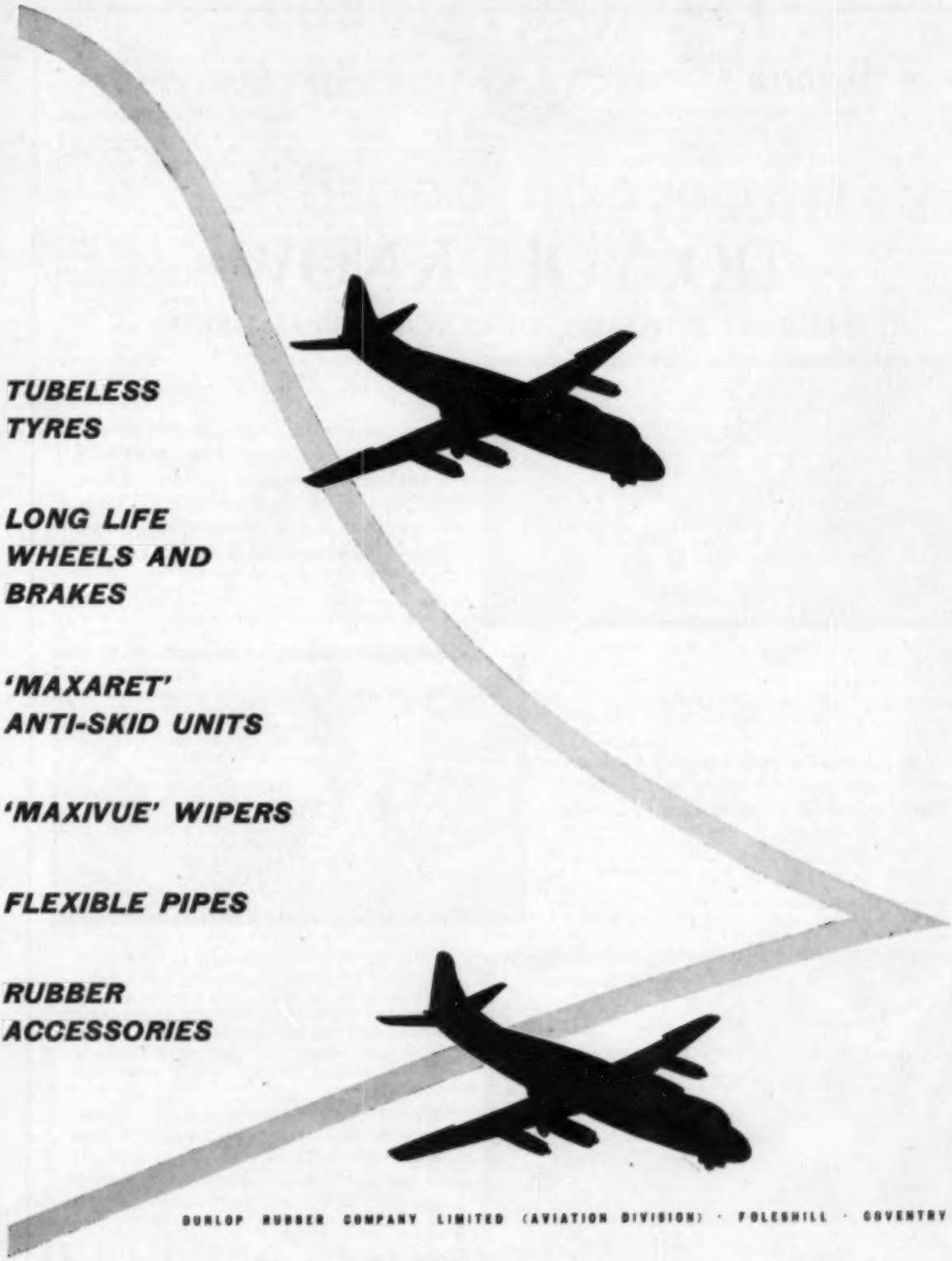

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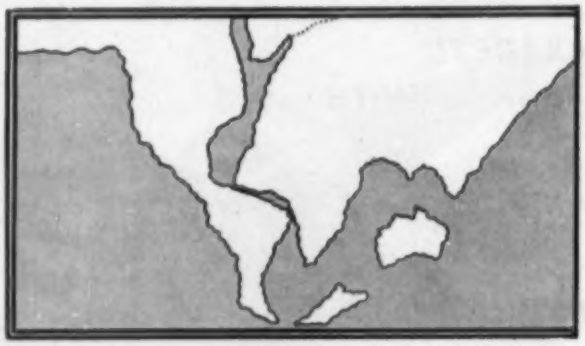

The continents are now separated, but traces of the old state still remain in the general structure and in the distribution of animals.

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CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

The Felixstowe Flying-boats

IN view of the current articles on the Felixstowe Porte flying-boats in *Flight*, I thought it worth putting on record that, until 1953, a hull of a flying-boat of apparently 1914-18 vintage was to be found at Bawdsey Ferry, near Felixstowe; circumstantial evidence suggests that this may well have been a Porte boat. If my memory serves me correctly, the fuselage was perhaps 30 to 35 feet long, and the decking was about half the width of the hull at its widest point, giving the characteristic "early flying-boat" cross-section. The hull was extensively covered with roofing felt and was in use as a fisherman's store; it may well have been destroyed in the floods of 1953.

Still to be found at Bawdsey are three flying-boat hulls of slightly more recent date and in a good state of preservation—two Supermarine Southamptons and what I assumed to be the hull of the Short R.6/28—characterized by its large size and beautiful lines. All these hulls were in use as inhabited houseboats.

I wonder if you, or any of your readers, have any information on the origin and history of these interesting relics.

Sheffield 5. ROBERT SHAW.

Before the Wrights

I AM distressed to see your correspondent Mr. John Garwood [November 25th] has fallen for one of the classic aero-historical red herrings. The Whitehead claim is best dealt with in the notes to the edition of the Wright papers published in 1953. The American authorities have gone into the matter and there is no reputable historian on either side of the Atlantic who takes the Whitehead claim seriously. There were a number of energetic, and sometimes ingenious, men making would-be flying machines at the time, and the wish to fly was naturally father to the thought—and the report, I fear.

Mr. Garwood will, it is hoped, be amused when he finds that one of the affidavit-signers had a financial interest in a biography of Whitehead!

London, W.1. C. H. GIBBS-SMITH.

Navaid Efficiency

WITH reference to L.A/C. Harmer's letter in your issue of November 25th, perhaps a more generally acceptable answer to the question "What has replaced M.F. D/F.?" would be "M.F. radio-beacons and the radio compass."

But it depends on how you look at it. Had Mr. Abrahams [the earlier correspondent] been a U.S. citizen his question would have been "What has replaced the four-course radio-range?" And L.A/C. Harmer's U.S. counterpart would have written to you saying "V.O.R." No doubt, there are interested parties who would inform you that Mr. Abrahams has got it all wrong—that M.F. D/F. never existed as an aeronautical navigational aid; or that, if it did, then its modern replacement will be a device called TACAN.

But for the time being—despite the appearance, year by year, of revolutionary navaids with handy bisyllabic labels—the airlines go on installing radio compasses in their aircraft, and many of those responsible for providing ground facilities purchase radio beacons and V.H.F. D/F. So they appear to constitute the real answer—at the moment. One day, perhaps, out of the feverish activity in those circles where radio aids to navigation are discussed philosophically, developed, designed and finally produced, the ultimate solution will emerge. It will be the aid which can be used anywhere in the world; it will not be subject to site or polarization error and will be suitable for long- or short-range navigation.

Till then, Mr. Abrahams will be entitled to sigh for the roses of yesterday, and L.A/C. Harmer, and others equally enthusiastic, will be ready to convince him that their latest toys, each and all of them, can cure his nostalgia.

Chelmsford, Essex. L. A. SWEENY.

I WAS most interested in L.A/C. Harmer's letter [November 25th] on D/F Efficiency and not in the least surprised at the results obtained on the Malta homer at Dingli.

In January 1939 a few of the then "R.D.F."-trained N.C.O.s and airmen, myself included, took the first mobile station to leave this country to Dingli; together with a Mk I G.L. set which subsequently arrived, we provided the sole R.D.F. cover for Malta until more equipment and staff arrived in June 1940—and, incidentally, no civilian was killed in a raid until we were off the air for three days after losing a mast in a gale.

The point of all this is, of course, that radio propagation conditions are exceptional in the Mediterranean from time to time, and it would be interesting to learn if any coincidence has been found between freak ranges and particular weather conditions. For example, with a warm south-east wind blowing from Africa there is usually a hefty temperature inversion which does the trick. We tried to find the co-relation ourselves from one of the later stations (C.O.L.) on the north side of the island, very ably assisted by such information as Norman Smith and his staff could give us from the met. office; but events were rather against such an undertaking at the time!

To conclude with a "line": we did get a reflection, one night, from the coast of Greece, and some phenomenal ranges on shipping. Anything comparable with aircraft at nought feet from the homer?

As a footnote, I would be delighted to hear from any of the original staff of "241" and "242" who happen to read this letter.

Reading, Berks. R. T. TOWNSON.

[Letters addressed c/o the Editor and marked "Correspondence November 28th" will be forwarded.—Ed.]

Veteran Fokkers

REGARDING the Fokker F.VIIa which recently returned to Holland and of which you printed a photograph on page 728 of the issue of November 4th, this is not an ex-K.L.M. aircraft as supposed. It started life as CH-158 (c/n 5054) and was delivered to Balair in March 1928. On November 2nd, 1929, it was sold to the Danish D.D.L. as OY-DED. It flew in D.D.L. livery until it was, in 1946, sold to Sweden as SE-ASE. In 1953 it was bought by Dansk Luftfart Service as OY-ASE and as far as I know it still carries this registration.

It is perhaps interesting to note that another old Fokker airliner is still flying in the Belgian Congo; this one, OO-AGI, is a three-engined F.VIIb and it is owned by the Société Avia. It is not of Fokker origin, because it has been built under licence by the Belgian S.A.B.C.A. company.

Wassenaar, Holland. E. VAN DER KLAAUW.

FORTHCOMING EVENTS

Jan. 5. R.Ae.S.: Young People's Lecture: "Test Flying—Current Problems and Techniques," by W/C. R. P. Beamont, O.B.E., D.S.O., D.F.C., A.R.Ae.S.

Jan. 6. Helicopter Association: "Economic Production of Helicopters—Future Possibilities," by L. J. Harper.

Jan. 10. R.Ae.S.: Section Lecture: "Some Modern Structural Problems," by Prof. W. S. Hemp, M.A., F.R.Ae.S.

Jan. 12. R.Ae.S.: Presidential Address by N. E. Rowe, C.B.E., B.Sc., F.C.G.I., F.I.A.S., F.R.Ae.S.

Jan. 12-13. British Welding Research Association: London Meeting on Increasing Productivity by Welding.

Jan. 14. British Interplanetary Society: "Space Ship Instrumentation," by R. A. Waldron, B.A., Grad. Inst.P.

Jan. 14. Women's Engineering Society: New Year Luncheon.

Jan. 17. R.Ae.S.: Section Lecture: "Crack Detection in Aircraft Structures," by Dr. W. Deck, Federal Aircraft Factory, Switzerland.

Jan. 20. Institute of Navigation: Some Meteorological Aspects of High-Level Navigation—(1) "Jet Streams in Flight," by Capt. B. C. Frost (B.O.A.C.); (2) "Forecasting Jet Streams," by J. K. Bannon and T. H. Kirk (Meteorological Office).

Jan. 21. Aircraft Recognition Society: Ninth All-England Recognition Contest.

Feb. 10. Helicopter Association: "Helicopter Control Systems," by J. S. Shapiro, Dipl.Ing., A.F.R.Ae.S.

Feb. 11. British Interplanetary Society: Birmingham Branch: "Aerodynamic Considerations of an Orbital Rocket," by W. F. Hilton, Ph.D.

Feb. 13. Institute of Transport: Brancker Memorial Lecture by R. S. Damon, President, Trans-World Airlines.

R.Ae.S. Branch Fixtures (to Jan. 26th):—

Jan. 2, Derby, Annual General Meeting. Jan. 3, Belfast, "Accident Proneness," by Dr. J. A. Smiley. Jan. 5, Isle of Wight, "Noise of Jet Engines," by F. B. Groatrex. Jan. 9, Glasgow, "Helicopters," by R. Hafner. Jan. 10, Boscombe Down, "Fatigue—the Metallic Deathwatch Beetle," by D. C. Smith; Bristol, "Aerodynamics and Associated Problems," by R. F. Creasey. Jan. 11, Brough, "Passengers and Freight Handling by Transport Command," by W/C. P. J. George; Chester, "Supersonic Flight," by G. A. V. Tyson; Manchester, "Analogue and Digital Computers Applied to Aircraft Design," by J. Arrowsmith; Weybridge, Brains Trust. Jan 12, Cheltenham, "Liquid Springs: Progress in Design and Application," by A. E. Bingham. Jan. 17, Bristol, "Powerplants for Supersonic Flight," by Dr. E. S. Moult. Jan. 24, Bristol, "Aeroelastic Problems in Connection with High-Speed Flight," by E. G. Broadbent; Belfast, "The Turbulent Atmosphere," by E. Hyde. Jan 26, Isle of Wight, "Interplanetary Flight," by A. V. Cleaver.

THE INDUSTRY

Potentiometer Production

SINCE Kelvin and Hughes, Ltd., began making their instrument components available to a general market a few months ago, their production of sine/cosine potentiometers has been doubled. Orders have been received from companies manufacturing equipment such as ground and airborne radar, aircraft navigational aids and computing instruments.

The shop in which the potentiometers are built has been moved from one of the company's factories at Barkingside, Essex to another Kelvin Hughes factory at Basingstoke, Hants. There, more than double the floor space has been made available and special equipment installed. These new facilities now enable the company to handle large numbers of precision windings in very fine, precious-metal wires.

Of the three main types of Kelvin and Hughes sine/cosine potentiometers one is believed by them to have the longest life and to be the most accurate for its size of any manufactured in this country. An accuracy of 0.3 per cent is guaranteed, and a life at this accuracy in excess of five million revolutions has been attained in laboratory tests.

Another type, probably the smallest sine/cosine potentiometer in the world, has an accuracy of 0.5 per cent and is only 1¼in in diameter. The third type is a double-card pattern which gives sine and cosine outputs independently for two input signals.

Formers for the potentiometers are made from glass in the company's glass shop where, mainly, precision optical work is undertaken. Other types of formers are made from "Mycalex" and from a new tough, synthetic ceramic, "Hylumina," developed by an associated company.

A New Floor-covering

FIRE resistance is one of the characteristics of a new carpeting material known as Harduraloop. It is made in two grades, having either (a) a looped pile of Ardil and wool, or (b) Ardil and viscose rayon, in each case with a rot-proof backing of polyvinyl chloride. Ardil is a synthetic fibre developed by Imperial Chemical Industries and is very similar to wool in appearance. The new material is claimed to give at least three times the wear of cut-pile type of carpeting and the loops are so firmly embedded in the p.v.c. backing that they cannot be dragged out even with a pair of pliers. Other advantages claimed are that the material does not stretch, that it is equally amenable to sweeping, vacuum cleaning and dry or wet cleaning, and that it can be easily cut to shape without the need for binding the edges. It is available in a range of ten colours including several mixtures.

A.R.B. approval has been obtained for Harduraloop as an aircraft furnishing material. The manufacturers of the new carpeting are S. and J. Walsh, Ltd., St. Lawrence Street, Great Harwood, Blackburn.

This Trojan crew car was recently built for British European Airways by Trojan, Ltd., Purley Way, Croydon, Surrey. Powered by a Perkins P3(V) diesel engine developing 41 b.h.p. at 2,400 r.p.m., it has seating for 12, including the driver, and a heater is fitted. A fuel consumption of 40-45 m.p.g. is claimed.

New Pack for Aircraft Components

A PACKING material claimed to offer the advantages of hair or fibre packing at greatly reduced cost has been developed by the 20th Century Packing Company of Thames Ditton, Surrey, who specialize in aircraft packaging. Known as Nylonpac, the new material consists of vegetable fibre bonded with nylon, and provides safe, efficient "bedding" for fragile articles such as radios, electrical components and instruments. It is available in a range of densities, in blocks up to 4ft by 2ft by 10in thick, and in smaller sheets down to 1½in thick. It can also be supplied spray-coated with plastic, to provide a smooth protective surface for articles with a delicate finish.

An instrument is bedded in Nylonpac.

Nylonpac is produced by immersing the fibre in a nylon solution, then heat treating it to drive off the solvent and cure the nylon. This treatment coats the individual strands for bonding and also, to a degree, impregnates the material with nylon. As a result, Nylonpac possesses a high strength factor and is capable of rapid recovery from dynamic or static loading. It also has a high resistance to perishing, in any climate.

IN BRIEF

Following the resignation of Mr. A. Hessell Tiltman, B.Sc., F.R.Ae.S., from the chairmanship and from the board of Tiltman Langley, Ltd., his place as chairman has been taken by Mr. W. R. Tomkinson, T.D., F.C.A., who has been a member of the board for a number of years.

* * *

Among the aircraft components which Dunlop are showing at the Indian Industries Exhibition in Delhi are a thermal de-icing system and a Maxaret anti-skid control.

* * *

Saunders Valve Co., Ltd., announce that Mr. Jack Furzey, from Rotax, Ltd., has joined the aircraft division of the company, where he will be in charge of development.

* * *

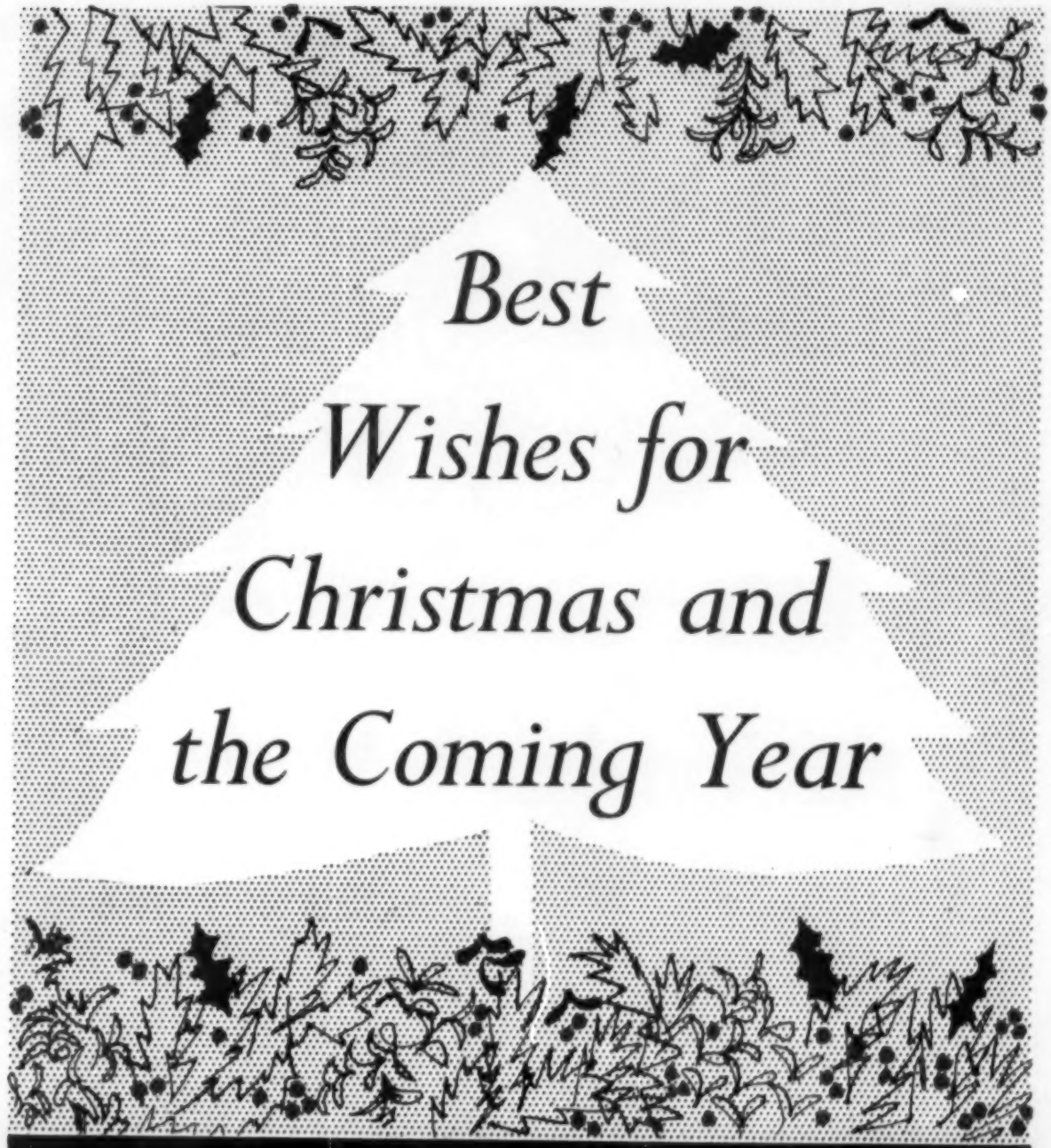
Two new appointments in the development and research departments of the Mond Nickel Co., Ltd., are announced. Dr. G. L. J. Bailey becomes superintendent of the platinum metals research laboratory at Acton, in succession to Dr. E. C. Rhodes; and Mr. E. J. Bradbury has been appointed assistant superintendent in Birmingham.

* * *

A newly-formed company, High Precision Engineering, Ltd., has recently taken over the business of Weir Precision Engineering, Ltd. The intention of the new company is to carry out the manufacture of special purpose machine tools, gauges, press tools, jigs and fixtures. The directors are Sir Alliott Verdon Roe (chairman), Mr. Geoffrey Verdon Roe (managing director) and Messrs. Lawrence Leech, C. K. Dowman and Royce Verdon Roe.

* * *

The Minister of Fuel and Power has appointed Mr. A. N. Irens, of the Bristol Aeroplane Co., Ltd., to be chairman of the South Western Electricity Board. Mr. Irens joined Bristols in 1939 as assistant electrical engineer and in 1943 was appointed chief electrical engineer, later becoming chief electrical and general services engineer. In this last post he was responsible for supervising the company's engineering services and for the setting up of power stations in various parts of the works. He has been a part-time member of the South Western Electricity Board since its formation in 1948.



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"If he doesn't bring you all you ask for this year – let Helliwell's do it in 1956"

Seasonal Greetings to all our friends in the Aircraft Industry from all at Helliwells – Walsall, Aberdare, Elmdon and London

Three per cent of the Heron order-book (see item below) is seen in this new air-to-air view from Hatfield. The aircraft shown are VP-BAP, second Heron for Bahamas Airways; VR-NCO, sixth for West African Airways; and (nearest camera) G-AODY, third for Dragon Airways.

CIVIL AVIATION

COMET 3's WORLD TOUR

WE have received from a correspondent in Australia this eye-witness account of the scene of the Comet 3's arrival at Sydney on December 4th:—

"Yesterday afternoon, at a quarter to five local time, the Comet 3 arrived at Sydney and was greeted by the largest crowd ever seen at Mascot. The airport was jammed with people, every available public area was packed, any flat-roofed building bore a crowd, and the airport boundaries were marked by a living fence. The railway embankment alongside the maintenance area was a seething mass, which slowly, and then rapidly, expanded down the slope, across the creek and on to the taxiways. On the far side of the aerodrome the same was happening.

"From the west the aircraft appeared, passing overhead in a wide circuit, to return for a formal presentation which aroused the audience to gasps of admiration for the beauty of the Comet's lines. Then once again into a wide circuit for the approach. But by now the crowd was getting out of control and had flooded across the runway. Cunningham pulled up smartly and away into another circuit. By the time the Comet was on the approach again, additional police had managed to get the crowd under control along the runway. But during the taxy-in, the enthusiasm of the thousands of visitors again overcame their prudence and a mass of people began to cover the tarmac. The Comet was completely surrounded the moment the brakes were on. It was some time before steps could be moved up and then only by driving a truck directly in front of them.

"A Qantas Super Constellation from San Francisco which arrived a few minutes later had to taxi through people streaming across from the T.A.A. terminal area. It is really surprising that there were no casualties. Not until a Qantas passenger coach was driven through the crowd to the foot of the steps could the passengers and crew from the Comet disembark, amidst loud cheers. Customs regulations could not be enforced, and the duty doctor would have run out of serum long before he could have vaccinated all those who infringed the quarantine area around the Qantas aircraft. Five hours afterwards many spectators were still looking at the Comet as it gleamed softly under the tarmac lights."

From Sydney the Comet flew to Melbourne, and from there on December 9th to Perth, making the 1,850-mile journey in five hours. From Perth, after a two-hour stop, the aircraft made a very fast trans-Australia flight to Sydney, covering the 2,055 miles in 4 hr 6 min (a new Australian record). Between Perth and Adelaide, aided by a tail wind, a true air speed of 582 m.p.h. was reached.

The Comet left Sydney on its homeward flight on December 12th, making a fast 2 hr 40 min trans-Tasman crossing to Auckland. After a 3½ hr stop there it flew on to Fiji, arriving there after a 2 hr 50 min journey, and leaving again for Hawaii after a ten hour stop. The Comet's arrival at Honolulu on December 14th, after covering the 2,700 miles in 6 hr 50 min, was marked in the traditional local manner by Hula dancers, who draped a garland of flowers over the aircraft's nose. The Comet was due to leave Honolulu for Vancouver last Friday after a two-day stop-over in the Pacific island.

According to the original flight plan, which has been followed closely, the Comet was due back at London Airport yesterday morning, December 22nd.

B.E.A.'s FINE SUMMER

IN the current issue of the *B.E.A. Magazine*, "heartening results" are announced by Lord Douglas of Kirtleside, the Corporation's chairman. During the first six months of the current year (April-September inclusive), he reports a net profit of £2.46m, an improvement of more than £1m on the profit for the corresponding period of 1954. The number of passengers carried (1,450,000) showed an increase of 18 per cent, and the load factor went up from 70.2 to 72.3 on international services, and from 74.8 to 78.8 on domestic services. October, the first of the winter months, had produced a £27,000 profit, compared with a £12,600 loss in October 1954, and productivity of employees had improved by 24 per cent.

HERON CENTURY

OF the 100 de Havilland Herons now sold, 89 are now in service, in 19 different countries. The latest to be ordered will be used by the Shell Petroleum Co. as an executive transport; the same company, incidentally, is already operating two of the 15 executive Herons now in service. Eight of the remaining 13 are operated by commercial concerns and five by air forces. The number of Herons in regular airline service is thus 74. Carrying up to 17 passengers in "mainliner" comfort, the Heron is powered by four Gipsy Queen 30 Mk 2s, each of 250 h.p.

AIRWORK STOP ATLANTIC SERVICE

AIRWORK'S transAtlantic airfreight service, inaugurated last spring, ceased to operate on December 18th. Mr. M. D. N. Wyatt, chairman of Airwork, said on December 15th that the service was being suspended because present Government policy made it impossible to recoup the losses so far entailed. "We expected," said Mr. Wyatt, "a permit to operate passenger charter flights from the United States Government. This would have enabled us to make more economical use of our aircraft. The British Government refused to take the necessary action on our behalf. Although we are the official British cargo flag carrier across the North Atlantic, we have not received one pound of government freight."

The Airwork freight service was a thrice weekly operation to Montreal and New York *via* Prestwick and Gander. It is understood that the company's three DC-6As, due for delivery next year, have now been sold.

NAPIER-LOCKHEED DISCUSSIONS

TWO Napier engineers, Mr. D. C. Greenwood and Mr. A. G. Honeyman, left London Airport for Burbank on December 2nd in response to an invitation from the Lockheed Aircraft Corporation to assist them in making a full assessment of the Napier Eland turboprop as a powerplant for the Electra. These discussions follow a recent visit to the Napier works at Acton by Mr. Robert Gross, Lockheed's president, and Mr. Hall Hibbard, vice-president (engineering).

Elands are now installed in three twin-engined aircraft—the Varsity test-bed in which the engine first flew, the Ambassador prototype G-ALFR, and a modified Convair 340 demonstrator, which is expected to fly in its new form after Christmas.

SILVER CITY'S RECORD YEAR

SOME impressive statistics for Silver City Airways were quoted on December 10th by Mr. E. C. Mekie, chairman of British Aviation Services, Ltd., the parent company of Silver City, Aquila, Britavia and Air Kruise, on the tenth anniversary of B.A.S.

During the financial year ended on September 30th, said Mr. Mekie, Silver City carried 70,190 short tons of freight, including 56,153 vehicles, and 162,497 passengers. On a tonnage basis (mail excluded), Silver City could now claim to be the largest air freight carriers in the world. The entire tonnage was not confined to vehicles carried on their cross-Channel car ferries; general freight totalled 7,608 tons. Moreover, the company's private airport at Ferryfield had set new records of its own during August, handling 13,262 tons of freight—58 per cent of the total freight turnover at all British airports and five times more than any other British airport during the same period.

Ferry traffic carried by Silver City had increased by 32 per cent during the year, and further increases were expected in 1956. Three more Bristol 170 Mk 32s—Superfreighters—would be delivered in the spring, bringing the fleet of this type to a total of 12 aircraft, and the number of Mk 21 Freighters operated by

CIVIL AVIATION . . .

Silver City had recently been increased from six to eight. In addition, Silver City had secured rights over all future production of Superfreighters, involving, it is believed, up to six more aircraft. Announcing these purchases, Mr. Mekie pointed out that since 1948 his group had bought over £2m of British aircraft for the air ferry. Some of the aircraft now on order, he indicated, would be used to provide reserve capacity during peak periods and to minimize the effects of mechanical delays at such times.

Mr. Mekie also announced a fares increase of 15 per cent on the air ferry services in 1956. The company, with a seven-year record of fare reductions, had hoped to avoid this step, but rising costs made it inevitable. In March 1955, he recalled, I.A.T.A. operators raised fares by 15 per cent, but Silver City did not follow suit, having sold 44 per cent of space available during the year. However, fares charged during 1955 had been "quite uneconomic."

"Can't understand these people who watch it all the time."

BREVITIES

AN order for two L.1049H Super Constellations, valued at £560,000 each, has been placed by United States Overseas Airlines, an irregular carrier. The company at present operates nine DC-4s on contract and charter services. It is estimated that the two 1049Hs, for delivery in mid-1957, will increase the airline's present capacity by 70 per cent.

* * *

Of 8,963,000 hours flown by all types of U.S.-registered aircraft in 1954, business aircraft logged by far the highest share of the total—3,875,000 hours, or 43 per cent. Percentages for other forms of civil flying were as follows: pleasure, 21 per cent; instructional, 14; agricultural, 8; industrial (including patrol and survey), 8; commercial (passenger and cargo), 6; experimental and test, 1.

* * *

An inquiry into the loss of a K.L.M. DC-6B closed in The Hague on December 12th. The inquiry stated that, through lack of evidence, it had been unable to find the cause of the accident. The aircraft disappeared over the North Sea on August 23rd, 1954, and much of the wreckage was subsequently retrieved. An early theory that the DC-6B might have been struck by a discarded tip-tank was rejected after extensive inquiries among NATO air forces.

* * *

Dollar Associates Inc., a firm of Pacific steamship operators, are reported to have acquired South Pacific Airlines, who recently received a five-year temporary certificate from the C.A.B. to operate between Hawaii and Tahiti *via* Christmas Island. The airline has for some two years been seeking U.S. type-certificates for its Solent flying-boats, which are now being overhauled at Oakland, California. A refuelling base is said to be under construction on Christmas Island.

THE IDEAL MOMENT

NO wonder the good-looking young man was smiling so engagingly at the stewardess. She had the matchless beauty, the improbable warm loveliness of those girls in the glossy airline brochures whose slender arms invitingly proffer a tray of cocktails. She was doing the same for him, her neatly costumed form so distractingly close . . . it seemed that, unless he watched what he was doing, he would surely knock the whole lot over, duty-free Benson & Hedges and all.

He himself was surpassingly handsome: the sort of young man one sees on almost any page of a woman's magazine, slightly out of focus behind a tearful young woman who is saying: "Clive, oh my dear, I never thought it could end like this." He was tastefully attired in a dark suit, and doubts that he was anything but a well-travelled and successful sales executive were instantly dispelled by his thickly labelled briefcase and the Homburg in the hat rack. A young man, it might be assumed, who took precious care of his appearance, judging by his buckled suède boots and high-aspect-ratio, Johnny-Ray-type bow tie.

A delightful young couple in the seats behind were smiling indulgently at their little girl, who was offering her teddy bear a lick of lollipop. Her mother was dark and lovely and rather mysterious, and a critical observer might have thought it surprising that she should have a child who was mousy-haired, portly, and rather cross-eyed. That those characteristics had not been inherited from the other side of the family was apparent from a study of her father who, rather oddly, was occupying the window seat: oddly, because most gentlemen usually let their ladies take this seat; yet his wife looked the sort who usually make their preferences quite clear, and one assumed that she had perhaps chosen the aisle position intentionally, glad of an opportunity to display to the fullest advantage her close-fitting, bejewelled black dress. He was young and, again, exceedingly good-looking.

Across the aisle was an Oriental, erect and expressionless, his massive plumed turban and shimmering silk gown adding to the scene a touch of Asiatic mysticism and inscrutability. Next to him, appropriately balancing Orient with Occident, sat an Englishman. That he *was* an Englishman was immediately apparent from his trim cavalry moustache, his curly-brimmed bowler hat, and the tightly furled umbrella leaning against his knee. Moreover, a copy of *The Times* and *The Illustrated London News* lay on his lap, and—conclusively perhaps—he seemed to be sternly resisting the temptation to have a quick look at the stewardess's ankles, which at that moment were most conveniently positioned for appraisal.

In the seat behind, a sweet old lady was embroidering a knitted tea-cosy. What gentle thoughts lay beneath those soft grey hairs, upon which was mounted an amorphous velvet hat? Probably she was musing upon the cosiness and comfort of modern air travel . . . just like being in the drawing-room at home, having tea with Miss Micklethwaite.

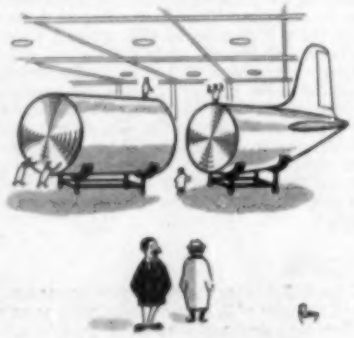
Next to her, evidently asleep, reclined a burly African chieftain, his splendid robes spreading richly into the aisle. In the hat-rack could be discerned his assegai and tom-tom. His seat was fully reclined—to the discomfiture, it appeared, of the prim, middle-aged lady behind, whose hat seemed to have been knocked slightly askew by the impact. An American who sat beside her, wearing a ten-gallon Stetson and a flowered Hawaiian play-shirt, was absorbed in a copy of *Home Notes*.

Through the cabin windows a flossy fairyland of cloud could be seen, apparently motionless. The tastefully styled cabin interior—undoubtedly the work of fashion designer Henry Dreybother—imparted a tone of restrained elegance.

Suddenly, a commanding voice rang through the cabin: "Hold it, everyone!"

The shutter clicked, and another publicity photograph had been taken.

J. M. R.



". . . and this is the high-density version."

CORRECTION

IN a previous issue we attributed to Mr. Fred Begorrah the statement that "Mr. Charlie Snodgrass is the most untrustworthy, low-down, conniving sniveller in the long-haul air transport business today, and how he has kept out of gaol so long I just don't know." Mr. Begorrah's solicitors have pointed out that he really meant medium-haul air transport.

AIR TRANSPORT AND THE NATION

"Stumbling into the Air Age": the Air League's Call for a Revised Policy

SENIOR members of the Government last week received a memorandum from the Air League of the British Empire urging "the evolution. without delay, of a comprehensive British national air transport policy." The Council of the Air League, the memorandum continued, did not propose to take part in the controversy on the abandonment by the Ministry of Supply of the Vickers 1000. Nevertheless, this incident afforded an excellent instance of the evils which flowed from the lack of a considered and co-ordinated air transport policy.

"The Minister of Supply," the memorandum said, "has indicated that he could not devote money to the development of an aircraft without a home market, and that since B.O.A.C. does not require this aircraft, no home market exists. But if in fact B.O.A.C. did require such an aircraft, its order could not possibly have been more than six or eight, and that does not constitute an adequate home market for an aircraft of this size and cost. Moreover, if B.O.A.C. does not need this aircraft, this fact must have been known several years ago, since B.O.A.C.'s plans are made several years ahead. It is true that the Corporation, at the time the V.1000 was planned, were asked to state their requirements. There the matter appears to have ended, and during the whole of the intervening period, the only prospective customer was Transport Command, with its order for six, a totally uneconomic order for such a costly aircraft, expensive not only in money, but in design manpower. Thus the Ministry was willing to proceed with this costly undertaking with an assured home market of no more than six aircraft. If such an aircraft in this category was to be undertaken, it should have been in close consultation not only with Transport Command, but with B.O.A.C., and not only with B.O.A.C. but with B.O.A.C.'s partners on the Empire routes as well, for they shared B.O.A.C.'s need for a long-range aircraft of great flexibility . . .

"The Minister of Supply and the chairman of B.O.A.C. have just stated that discussions are proceeding about the possibility of bringing into production in the 1960s a turbojet aircraft to fly non-stop between London and New York. Is Transport Command being brought into this picture? Are Qantas Empire Airways, South African Airways, and the Canadian airlines being consulted as to their requirements? Their combined needs would constitute something which could justly be called a home market when it is a question of a large modern jet transport costing possibly more than £1m each, and some 40 of which might well have to be sold in order to break even . . .

"Another reason given for the abandonment of the V.1000 and its civil version is that it is late. But the virtual certainty of its being late should have been taken into consideration by the Ministry of Supply and the Air Ministry when the order was first placed. Practically all large and advanced aircraft nowadays are delayed in delivery . . . Even if, in the circumstances, the decision to abandon the V.1000 was correct, it still remains true that these circumstances should never have arisen, and since a later aircraft is now apparently being planned, it is vital that the same mistakes should not be repeated . . .

"Again, in considering the specifications of this new large British civil jet aircraft, the Ministry of Supply should follow the excellent example of the manufacturers of the Herald transport aircraft, and should consult widely with possible foreign purchasers as well as with Transport Command, B.O.A.C. and B.O.A.C.'s Commonwealth partners. It should also be prepared to finance the aircraft's development flying. Above all, it must see the project through and not abandon it half-way. The history of British aircraft production since 1941 is littered with more or less abortive projects in which millions of public money were sunk.

"The V.1000 incident is, however, only one aspect of the question of a co-ordinated air transport policy. There is the possibility of further widening the home market through making it possible for the British independent air operators to re-equip themselves with modern aircraft. . . . The Government already grants contracts for trooping, but these contracts are of such short duration that no operator can invest the millions of capital necessary to purchase modern aircraft to carry them out . . . it should be possible for the Services to place bulk travel contracts covering at least seven years."

There were many other matters, the memorandum continued, which were not being actively pursued because no Minister appeared to be specifically charged with overall responsibility for air-transport development in all its aspects. A case in point was the failure of the British Customs administration to adapt its procedures to the requirements of air transport. There was, for instance, urgent need for the establishment of a free Customs area at London Airport. London was ideally situated to become the air cargo centre of Europe, but the opportunity was being lost, and the traffic was being diverted to Amsterdam and Frankfurt, where free trans-shipment areas had been created.

Summing up, the memorandum declared: "All the foregoing considerations point, in the view of the Council, to the need of placing all air transport development in the charge of a senior Minister of Cabinet rank, who would be responsible for seeing that all relevant matters are co-ordinated and welded into an all-embracing policy. For lack of a clear lead and determined support by the Government, this country is stumbling into the air age, when it should be moving powerfully forward on a broad front, inspired by a bold, considered and co-ordinated policy. . . . Because of the absence of a directing mind on a high level, public money is being wasted and commercial opportunities are being missed, while the mobility of our Fighting Services is entirely inadequate for the needs of modern war, both hot and cold."

V.1000 AFTERMATH: THE COMMONS DEBATE

FEW new facts were elicited during the recent debate in the House of Commons on the cancellation of the contract for the Vickers V.1000 aircraft, but it was interesting to note that there was no real unanimity among those taking part as to the correct interpretation of this very controversial decision.

Mr. Paul Williams (Con. Sunderland South), who initiated the debate, described the cancellation as "one of the most disgraceful, most disheartening, and most unfortunate decisions that has been taken in relation to the British aircraft industry in recent years." He contended that there would be a requirement during the next 10-15 years for a long-range pure jet first-class transatlantic aircraft which, in his view, could be met only in the Vickers 1000.

He believed the project could be carried through if there were sufficient willpower to treat it as a national venture in respect of manufacture and operation. (Here Mr. Williams mentioned the reference in the Corporations' charters that they should buy British wherever possible.) It seemed to him that if the decision to cancel the Vickers V.1000 was confirmed, B.O.A.C. would be faced in the late 'fifties with a very difficult position, and by the early 'sixties it would inevitably have to buy American for its transatlantic services.

A. Cdre. A. V. Harvey (Con. Macclesfield) suggested that an independent body, as opposed to the Ministry of Supply, be asked to carry out an assessment of the V.1000. So far he was not convinced of the correctness of the Government's decision, certainly not from a technical point of view. He firmly believed that Vickers could be two years ahead of either Douglas or Boeing in this project. Nearly £3 million had been spent already and, for the sake of perhaps another £1,250,000, we should have a transatlantic aeroplane flying in 1959 or 1960.

But Mr. Charles Ian Orr-Ewing (Con. Hendon North) thought it was "poppycock" to suggest that the whole prestige of Britain would be affected by the decision not to go ahead with this aircraft.

The difficult question was whether to proceed with this aircraft in addition to the other projects. Mr. Orr-Ewing said that he and many other M.P.s had felt that, in the past, in both the military and civil field, we had tended to back too many projects and had thus spread our technical effort too thinly. It was a courageous decision to make at this moment not to go ahead with the V.1000. Agreeing that some projects must be dropped, Mr. William Shepherd (Con. Cheadle) described the position of the aircraft manufacturing industry as "extraordinary"; it acted as a vacuum, sucking in labour from every industry around it. It employed them at an efficiency far below the general level of the British engineering industry, involving a great waste of manpower and skill.

Mr. F. J. Errol, Parliamentary Secretary to the Ministry of Supply, stressed that the House had really been considering two separate aircraft —the military V.1000 and the civil V.C.7.

The Minister had decided to cancel the order for the military transport only after the most careful and anxious consideration and discussion with all concerned. Three main facts had been decisive: the military version could not meet the full specification in time; it might just have met the full specification but several years late; the long-range Britannia had gone forward well and, although not meeting the original military specification, could be made available earlier.

With no customer for the V.1000, the Minister had to consider the future of the projected civil version. The only possible home operator for it was B.O.A.C., who already had large outstanding orders and felt unable to spend more money on V.C.7s for delivery in 1960. The Corporation were satisfied that they could hold their own commercially on the North Atlantic route until well into the 1960s with the Comet 4 and the long-range Britannia. B.O.A.C. placed great emphasis on the superior performance of turbine-propeller aircraft compared with jets, and did not feel that the absence of a jet aircraft capable of flying non-stop from London to New York would seriously damage British air traffic in the early 'sixties.

BLUE RIBAND POSTSCRIPT

Britain and the Atlantic Route: Plea for a Renewed Effort

By FRANK BESWICK, M.P.

ONE thing at least was proven by the Government's decision to cancel the V.1000 contract—the very real interest of the British public in aviation affairs. That fact is not without significance.

The interest springs, I suggest, not from passing curiosity whipped up by the national Press, but from a deep-seated belief that the construction and operation of aircraft are bound up with Britain's future. The twin industries are accepted as a modern field of enterprise which, like nuclear power, can be exceptionally important in helping a comparatively small country to keep a major world position. If this factor is agreed, then it has great relevance to any consideration of the question of where do we go from here after the V.1000 controversy.

It is not for me to rule on the technical merits of the cancelled aircraft. More complete data than I possess was studied by men more competent than I. But it is fair to comment that this adverse decision was taken against a product of the firm which, above all others, on post-war performance on its civil aircraft, deserved to have been trusted.

The argument is put that this particular aeroplane was intended for a specialized route, that the number of machines needed for this one route is limited, and that Britain should now concentrate upon the types now selling and for which there is a bigger potential sale. There are two immediate answers to that argument.

Firstly, the claim that a straight jet aircraft capable of flying the North Atlantic non-stop is limited in selling potential to that one route is open to much doubt. The aircraft which can fly the North Atlantic non-stop will give extra reliable and efficient service on somewhat shorter stages. With less fuel and more payload they could give more economical return on less exacting routes. American Airlines have not ordered their twenty Boeing 707s for the Atlantic. Nor have United Air Lines ordered their thirty DC-8s for that route. Nor must it be assumed that with the continued build-up of air traffic that demand for longer stages will be confined to two American continents. There are, for example, far more people living in Africa and Asia (outside of Communist China) than there are in all the American countries, and within another decade there may well be much more reason for Europeans to travel to, and do business with, Africa and the East.

Transatlantic Proving Ground

Experience doesn't suggest that the transatlantic aircraft is not welcomed on other routes. Moreover, the bid for the blue riband route brings out the best in a big aircraft's potential. The requirements of the North Atlantic have the pace, the standard for the breeding of transport aircraft.

The argument that the transatlantic market means an esoteric, narrowly-specialist machine unsuitable for sale elsewhere cannot therefore be accepted.

The second point put forward to justify the V.1000 decision is that we must now concentrate our resources; that we have tried to do too much with too many types. Some of us have been arguing this for a long time. That the Minister of Supply should now agree is good—so far as it goes. But acceptance of the principle does not necessarily justify this particular application.

It is generally anticipated that in the near future there will be a cut-back in military orders. There is much more scope for concentration on the Service side. Indeed, changes in defence strategy may *force* a policy of concentration upon the industry. The answer to the concentration argument, therefore, is that the last sphere in which the policy should be applied is in that of transport aircraft.

As things are now, we are not so much concentrating as "coventrating" our civil effort. Mr. George Edwards says we are "abandoning the struggle" for the non-stop straight jet transatlantic project. At the moment that is true. The Minister, in reply, points to the transatlantic non-stop turboprop Britannia. But according to recent statements the Bristol Company is turning over the B.E.25 to further exploitation in American airframes. That must mean that the Britannia's successor will not be an all-British design. Our abdication from the big long-range market—the most important market of the future—is almost complete. Or, at any rate, it must be agreed that, from the view of Britain's export and balance-of-payment needs, the retreat from supremacy has gone further than the country can afford.

What, then, is to be done? Where do we go from here?

It is said that the Air Transport Requirements Committee, on which sit representatives of the Ministry of Supply, the Ministry of Transport and Civil Aviation, and the two Corporations, is calling for designs for a new jet aircraft which can leap-frog the DC-8 and 707 in performance—and, of course, the V.1000. It may be possible to do this. But it will take a big leap. Our post-war experiences in trying to cut out stages of growth have not been too happy. And the success of such a policy must depend upon the American companies virtually marking time. Or on British firms developing an aircraft much faster in the future than they have done in the past.

Is there a possibility, given the present organization of the industry, that any one British company can now put on this unique spurt in the design and development of the needed big machine? There is nothing in recent experience to suggest it. To an outside lay observer it seems to be very doubtful. It is more than doubtful whether any spurt could be rapid enough to catch up with the U.S. competitors—especially if *we scratch* the V.1000 and *they* build on the DC-8 and the 707. Why should this be so? Surely it is in large part due to the greater resources which our American friends can apply to any one project. The order for the tanker version of the 707 is said to be worth around 700,000,000 dollars. That must go a long way towards paying for extra facilities for solving the inevitable problems.

Because we recognize these facts is not to be defeatist; but if these big jobs need bigger resources we may well have to do something about it.

THE author, Member of Parliament for Uxbridge and Parliamentary Secretary to the Ministry of Civil Aviation in the last Socialist Government, expresses here a "lay observer's" afterthoughts on the recent decision to stop work on the V.1000. Some forthright opinions on the same topic were also expressed in a recent Air League memorandum, as reported on the preceding page.

Pooling of Resources

There are those who would say that an outright merger between two or three of the British firms with experience in the large-transport field is the necessary next step. Without going so far as that, how about a joint effort of three of the major British firms on this project of a large straight-jet long-range transport? Would not an all-out effort along these lines have advantages?

One firm claimed recently that its own facilities made it "almost independent of outside help" in the matter of testing of structure and airframe services of big high-speed aircraft, and research on new structural forms. Such facilities may well be adequate for a certain standard, or pace, of work, but not to meet this challenge that lies ahead. When one thinks of the stories brought back by travellers to the American scene it is surely impossible for any one British firm to be satisfied with the resources it can apply to a big project.

If a big bid of this kind is to be made in pursuance of national economic policy as well as in the interests of the industry itself, the question inevitably arises as to who will give the initial order. Two courses must be ruled out. One is the practically "open cheque" prototype order from the State, which resulted in the more expensive and spectacular post-war failures. Secondly, the British Air Corporations cannot be compelled to buy against their own commercial judgment, nor indeed to foot the bill for all the development flying.

The proposals I put forward as a basis for constructive discussions are as follows:—

(1) That the policy decision to devote part of British resources to a new large jet transport project be made by the British Government.

(2) That the specification be drawn up by the present Air Transport Requirements Committee, or a similarly constituted body.

(3) That one, or two, groups of British companies be invited to submit designs.

(4) That to the extent that the group submitting the successful design were unable to undertake financial responsibility for the prototype, then the State should provide the money. It is my belief that to this same extent the State should be given a financial interest in the companies concerned—but that idea may well be considered a separate argument!

(5) That B.O.A.C. should give a firm order for this aircraft provided that it fulfilled stated requirements as regards performance and delivery.

(6) That the Corporation be expected to carry out development trials as a No. 1 priority and should be financially recompensed for the expense they incur.

I recognize that the controversial core of these suggestions is the proposal to group companies together, and that I have not gone into any detail as to how this might be done. Clearly there is a wide range of possibilities, from the announced Bristol-Convair-Canadair collaboration to some outright merger. The most fruitful solution probably lies in between and can emerge only after earnest discussion.

What does seem more certain is that ideas along these lines should be explored seriously and urgently.

Mosquito P.R.34A RG 314 at Seletar with its No. 81 Sqn. crew before setting out on the last operational squadron sortie by this type of aircraft last week. (See paragraph below.)

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

The Last Mosquito Op.

THE final sortie by a Mosquito in operational squadron service with the R.A.F. was made on December 15th—just over fifteen years after the prototype aircraft, W.4050, first flew in 1940.

The last aircraft belonged to No. 81 Sqn. at Seletar and was a P.R.34A numbered RG 314. It made a reconnaissance flight over terrorist territory in Malaya. Now No. 81 Sqn. will take over Meteor P.R.10s.

Altogether, 7,781 Mosquitos were built, of which 7,200 were delivered to the R.A.F. During the war they served in almost every operational rôle; for Bomber Command they dropped 26,867 tons of bombs, while with Fighter Command they destroyed 600 enemy aircraft and 600 flying bombs.

The first operational sortie was flown on September 20th, 1941, by Mosquito W.4055 of No. 1 P.R.U. from Benson; the pilot was W/C. R. F. H. Clerke, who is now Wing Commander Flying at North Luffenham.

Mosquitos will best be remembered for their precision low-level bombing raids on such targets as Gestapo H.Q. buildings and Amiens prison, and for the first daylight raid on Berlin, which interrupted a speech by Goering commemorating the tenth anniversary of the Third Reich. All the Mosquitos' famous front-line contemporaries have already left operational squadron service.

The tense moment as Capt. A. Luty, O.C. No. 73 Air Dispatch Coy., R.A.S.C., waits for the green light to tell him to have the cargo containers pushed through the doorway of a Valetta over the Canal Zone during a supply dropping exercise.

Mid-Canada Line

MUCH of the survey work in connection with the siting of radar stations for the Mid-Canada Line has been carried out by the R.C.A.F.'s No. 408 Sqn., using the mapping facilities of the R.C.A.F. and the Canadian Army Survey Branch. The Mid-Canada Line consists of a series of unit detection and warning stations with main stations at appropriate intervals extending from the Labrador coast westward. All stations have landing facilities for helicopters, and these machines are being extensively used for transport in connection with construction of the stations as well.

Combined Rescue Exercise

EARLIER this month the helicopters of No. 275 Sqn., attached to Leuchars, held a combined exercise with a number of Scottish lifeboats in the North Sea. The boats sent out emergency radio calls to coast guards, who alerted the helicopters. "Injured" men were then picked up from the sea and transferred to the lifeboats, which brought them ashore. This was the first large-scale exercise of its kind to be held.

R.Aux.A.F. Appointment

IT has been announced that S/L. D. H. M. Chandler is to command No. 500 (County of Kent) Sqn., R.Aux.A.F., whose base is at West Malling, Kent. The Squadron's honorary air commodore is Sir Anthony Eden, the Prime Minister.

S/L. Chandler was born in 1923 and enlisted as an apprentice in 1938. He began pilot training in 1943 and served at No. 22 Air School, South Africa, and was then posted to the Middle East Communications Squadron. In 1947, he flew in No. 61 Group delivering Spitfires to R.Aux.A.F. squadrons, and two years later joined H.Q. B.A.F.O., Germany, and served with Nos. 3 and 11 Sqns. After a tour as an instructor, he went to Central Fighter Establishment early this year.

Cranwell Graduation

AT the passing out parade of the 66th entry of flight cadets of the General Duties, Equipment and Secretarial Branches from Cranwell on Tuesday of last week, Air Chief Marshal Sir Francis Fogarty, Air Member for Personnel, was the reviewing officer. The Sword of Honour was presented to Snr. U/Off. M. J. Griffiths and the Queen's Medal to Snr. U/Off. G. C. Hubbard.

Work on the runways of the College airfield is now practically completed and it is confidently expected that Vampire Trainers will begin to operate from it in February.

Aircraft Disposal

DURING the past year 343 aircraft, including 231 training aircraft, 72 bomber and reconnaissance aircraft, 18 fighters and 22 transports have been disposed of by the R.A.F. as surplus stores. The sale is normally conditional on the aircraft being broken up for scrap.

H.M.C.S. "Bonaventure"

THE new Canadian aircraft carrier H.M.C.S. *Bonaventure* is being completed in Belfast and is to be commissioned next October. Electrical and electronic equipment valued at about £1m has been ordered from Canadian firms in pursuance of the policy that as much Canadian equipment and material as possible should be incorporated in the ship despite the fact that she is being built in Ireland. H.M.C.S. *Bonaventure* is a light fleet carrier.

Auxiliary Affiliation

IT has been announced that the Hong Kong Auxiliary Air Force is now affiliated with No. 601 (County of London) Sqn., R.Aux.A.F., which is based at North Weald, Essex. It is intended that a close relationship between the two squadrons will be encouraged by regular exchanges of information and news and by extending hospitality to members visiting one anothers' country.

The Hong Kong Aux.A.F., was formed in 1949 and operates light aircraft on harbour patrol, light reconnaissance and internal security duties. Marshal of Royal Air Force, the Duke of Edinburgh, is Honorary Air Commodore of No. 601 Sqn., which is commanded by S/L. C. C. McCarthy-Jones. The Hong Kong squadron is commanded by W/C. J. E. L. Larson. No. 601 Sqn. is already affiliated with No. 2 (City of Wellington) Sqn. of the Royal New Zealand Territorial Air Force and with No. 24 (City of Adelaide) Sqn. of the Royal Australian Citizen Air Force.

THE CHRISTMAS BOOKSHELF

FEW phrases strike such terror into the hearts of husbands, fathers and friends as does today's reminder that there are only two more shopping days to Christmas. It heralds the period of panic purchasing, when maiden aunts dash out to find Technicolored ties that will never be worn, when wives invest in socks rather than darning wool and when the uninitiated buy books that are best used as doorsteps.

As our contribution to peace and goodwill in the family circle this year, we have sorted out a few of the new aviation books that are worth a place in the sack of every Father Christmas.

Without any reservations, we put *Fasten Your Lapstraps*, by Geoffrey Willans, at the top of the list, as the most entertaining book we have read for a very long time. Never has there been a more perfect picture of the people, places and planes we encounter whenever we travel by air from A to B; and the 67 illustrations by David Mathias are unbelievably funny. The more you have flown, the more enjoyment you will get from meeting again your inevitable fellow travellers—the hung-over; the oblivious; the brutal joker; the ex-Air Force type listening for slight changes in the engine note; and, of course, the old hand in the shape of Mr. Klug the Thuringian potash merchant.

After fun and games, how about a ghost story? Not the usual Christmassy kind; but the story of a once-great fighting ship and of the men whose deeds upheld her name. If you have read *Faith, Hope and Charity*, there is no need to praise Kenneth Poolman's ability and accuracy as an author. In his book *Illustrious* he paints a vivid picture of life aboard a great carrier in wartime, as seen through the eyes of some of her crew.

Here is all the glory of Taranto; the hell of dive-bombing attacks that sent H.M.S. *Illustrious* limping into Malta more dead than alive; the never-failing humour and good fellowship of "bird-men" and "fish-heads"; the might, majesty, dominion and power of the great carrier task-forces that paved the way for victory in the Pacific. Memories—ghosts from a past that seems almost unreal after more than ten years. But Christmas is the time when memories burn brightest, when loneliness is a little harder to bear in some homes, and when we all find time for reminiscing.

Not that *Illustrious* is a gloomy book. Far from it! The characters and incidents that fill its pages are the finest answer to critics who condemned *The Bridges at Toko-Ri* as imaginative and almost libellous. Take, for example, the occasion when "Jumping Joe" Clifton, air group commander of U.S.S. *Saratoga*, arrived on board H.M.S. *Illustrious* in his Hellcat, stalked up to the bridge, thumped Captain Cunliffe on the back and said "Hiya, captain, I'm mighty glad to know yuh! Say, you've got a mighty fine little ship here, yes *sir*!" And another time, when the commanding general of the South African Army complained: "I was in the bathroom looking out of the window and thinking how beautiful the mountain looked this morning, when . . . *whoosh*! . . . an aeroplane came roaring over my lawn, *underneath* my window. I was just wondering what had happened when . . . *whoosh*! it happened again." No doubt the pilot, Norman Hanson from *Illustrious*, found this useful training for his later low-level strikes against Japanese targets in the Pacific.

Six days after Hanson had shot up Sabang in his Corsair, another pilot took off in a Lightning for a reconnaissance flight over the Mediterranean. From this mission, Antoine de Saint-Exupéry did not return, and aviation lost perhaps the greatest of its writers.

The story of his life is told by John Pudney in *6 Great Aviators*, the other six(!) being A. V. Roe, Alcock and Brown, Lindbergh, Kingsford Smith and Neville Duke. It is a book to inspire teen-age lads, who are not yet sophisticated enough to wince at repeated references to "our hero" throughout the book, but who may snort indignantly when they read that "the Spitfire was still a top secret blueprint" in 1939 and that Roe's *bi*plane of 1912 was the first totally enclosed aeroplane to fly.

Despite such inaccuracies, this book should ensure a few hours' peace and quiet for any father who buys it for his son this Christmas. We cannot guarantee the same benefits from Roy Cross's *Supersonic Aircraft*, because it is one of those books for which youngsters will scream their heads off in vain until father has finished with it. In the short space of 63 pages, it explains very satisfactorily most jet-age technicalities and includes comprehensive details of all known dive and level supersonic aircraft.

In places, the writing style becomes a trifle laboured; but Mr. Cross has gained fame as an artist rather than as a writer, and the large number of illustrations have been chosen with an artist's eye for beauty and an enthusiast's knowledge of what is new and interesting. Best of all are his own paintings, which have never been bettered for photographic detail.

Talking of photographs, there is little doubt that any boy between seven and seventy would welcome *Flight Fly-Past*. It is a portfolio containing 24 large (10½in × 12½in) reproductions of some of the finest pictures ever taken by *Flight* photographers John Yoxall and L. W. McLaren. Here, on art paper, ideal for framing, are prints capturing the drama of jet night-flying "ops," the loneliness of long ocean patrols, the excitement of the never-ceasing quest for power and speed.

Finally, a book which has nothing to do with aeroplanes, but which, by its very beauty, must surely appeal to everyone—*Yachting World Annual, 1956*. No book to read once and forget, this is the sort of volume that becomes an old friend, to share countless evenings of dreaming by the fire in winter. All the grace and beauty of fine sailing boats are captured in its 123 art plates. Yachtsmen whose exploits have made them world-famous recount tales of the sea, mixing hazard and fear with breathless gaiety and quiet summer cruising. This is, in fact, a book for the expert or beginner, for the sailor or for anyone who can appreciate good stories, good pictures and a good book.

J. W. R. T.

THE BOOKS REVIEWED ABOVE

Fasten Your Lapstraps, by Geoffrey Willans. Max Parrish and Co., Ltd., 55 Queen Anne Street, London, W.1. Illustrated. 9s 6d.

Illustrious, by Kenneth Poolman. William Kimber and Co., Ltd., 46 Wilton Place, London, S.W.1. Illustrated. 16s.

6 Great Aviators, by John Pudney. Hamish Hamilton, Ltd., 90 Great Russell Street, London, W.C.1. Illustrated. 10s 6d.

Supersonic Aircraft, by Roy Cross. Macdonald and Co., Ltd., 15 Maddox Street, London, W.1. Illustrated. 6s 6d.

Flight Fly-Past. Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Pictorial. 7s 6d.

Yachting World Annual, 1956. Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Illustrated. 30s.

TWENTY-ONE YEARS OF FLIGHT REFUELLING (continued from page 946)

reached a level where the changes of the relative loadings of tanker and receiver might, in the case of certain aircraft, have an appreciable effect on the aircraft's handling characteristics in little over a minute. These developments are, of course, being passed on to the associated company which was formed as Flight Refueling, Inc., in America in 1948. It is this company which has now secured the adoption by the U.S.A.F. of the A.16 hose-reel unit which can be mounted in the space of a few hours in an aircraft's bomb bay to convert it immediately into a tanker. Presumably this is the principle which will also be applied to the V-bombers.

Another unexpected project came in 1952 when the company operated No. 201 A.F.S. for the R.A.F. with marked success. It was a jet conversion school for which the R.A.F. supplied pupils, instructors, controllers and aircraft (Meteor 7s, 3s and Vampires) while the company provided all maintenance. Between November 1952 and March 1954 some 16,500 hr were flown with a maximum of 36 aircraft, at a cost far lower than that which could have been achieved by normal Service procedure.

At the company's recent 21st anniversary dinner, no one could fail to sense the warm personal relationships existing throughout the company today. As Sir Alan himself puts it, "We refuse to admit that there is any line between the worker and the employer. There are no two sides of the fence. If there are, the fence must be broken down. Everyone in the company is a worker and, according to capability, aptitude, experience, character and temperament, the manager endeavours to put every man in the job at which he will be happiest. This is not always easy to arrange, but very often we shift a man four or five times in order that he may find his particular metier. Extraordinary as it may seem, every man is on the staff and, in consequence, incurs no penalty for late time-keeping or short-duration sickness." Sir Alan summarizes the policy of the company as: first, to create the idea; second, to sell the idea and get the contract; third, to get the team to do the job.

A happy idea first put into effect at the recent dinner is the presentation of a pewter tankard for ten years' service, a silver one for 15 years, and a gold one for 20 years. Recipients of all three (the awards are cumulative) were the company's service manager, P. R. Allison; a hangar foreman, W. J. Craig; the general services executive, W/C. H. C. Johnson; a director, Mr. Christopher Tonge; and, of course, the chairman and managing director, Sir Alan himself. A pewter and a silver tankard were collected by Mr. S. C. Gerard-Kealey, a director; Mr. George Moreton, foreman of the assembly shops; and Mr. G. H. C. Tadd, who is in charge of machine and tool maintenance.

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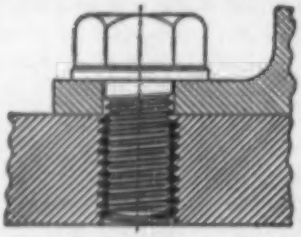

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The position is one of considerable responsibility and is a senior appointment. Applicants, preferably, should be not less than 35 years of age. Retiring serving officers with suitable experience are invited to apply.

Applications outlining details of experience, qualifications and present salary quoting DO/JF.52 should be addressed to:

The Personnel Manager, The Bristol Aeroplane Company Limited, Filton House, Bristol

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for work on designing and detailing general test rigs and equipment. Minimum of 5 years' experience though not necessarily in the Aircraft Industry.

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PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

APPLICATION No. 691. From Starways, Ltd., of Liverpool Airport, Liverpool 19, for a Seasonal Inclusive Tour Service to be operated with Dakota aircraft in conjunction with Nugents Air Trips for the carriage of passengers between Glasgow (Renfrew) and Jersey at a frequency of up to three return flights each Sunday during the season from May to October inclusive each year for a period of five years commencing May 1956.

APPLICATION No. 692. From Air Kruise (Kent), Ltd., of 1, Great Cumberland Place, London, W.1, for a Seasonal Inclusive Tour Service to be operated with Dakota or Bristol 170 aircraft in conjunction with St. Christopher's Tours, Ltd., for the carriage of passengers and supplementary freight between Lydd and Lourdes (Tarbes) at a frequency of one return flight weekly, to be operated on Tuesdays, during the season from June to September 1956.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3, Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained.

WHEN an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [4626

SITUATIONS VACANT

THE ENGLISH ELECTRIC COMPANY LIMITED AIRCRAFT DIVISION

Aircraft Materials Development Laboratory

ENGINEERS and metallurgists with degree or H.N.C. are required for a number of interesting vacancies in this laboratory to work on the development of new types of construction for structural use in high speed aircraft. The work covers the evaluation of ferrous and non ferrous materials, the development of forming and jointing techniques and the application of new types of materials. A considerable expansion of this laboratory is planned in conjunction with the company's research and development in advanced high speed aircraft.

APPLY, giving full details, to Department C.P.S., 336/7, Strand, W.C.2, quoting Ref. L.2. [4596

VACANCIES will occur early in the New Year for engineers having licences for Dakota/Dove and their engines, to be based in the Middle East. Long term appointments, good salary and allowances, gratuity on completion of contract. Fullest details in confidence to Airwork, Ltd., Overseas Division, Sutton Lane, Langley, Bucks. [4590

SITUATIONS VACANT

A message to any

DRAUGHTSMAN OR STRESSMAN

contemplating change of employment

Long before reaching a final decision on this matter, you will have realized its importance, the effects it might have on your family, living conditions, peace of mind, etc., and the extent of the costs involved.

We feel that you should be given the opportunity of discussing this question with our experts and, to this end, suggest that you write to us forthwith.

Naturally, we shall recommend that you join our own staff—that of a company well known in the aircraft industry—where your benefits would include the following:

(a) Competitive salaries.
(b) Increases awarded according to the merit of the individual.
(c) Adequate pension and assurance facilities.
(d) Provision of accommodation.
(e) Assistance with removal expenses.

Nevertheless, the final decision will remain in your own hands, so why not let us arrange a meeting?

Just send a brief resume of your career to date to Department 17 F, Box 8285. [4614

JERSEY AIRLINES

INVITE applications from pilots holding senior commercial or ALTP licences, to fill vacancies in their Heron and Rapide flight. Applicants should not be more than thirty years of age, and have at least 1,800 hours flying experience, of which a large proportion should be in command of multi-engined aircraft. A small number of pilots with lower qualifications may be considered for initial employment on Rapide aircraft. Applications should be made in writing to the Chief Pilot, Jersey Airlines, States of Jersey Airport, Jersey, C.I. [4605

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is extending its activities in this field to cover design and development work, and it is intended to create a self-contained team. Applications are invited from the following:—

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SENIOR, INTERMEDIATE AND JUNIOR DESIGN DRAUGHTSMEN

with aircraft experience, wishing to enter the Guided Weapons field or with a good engineering background in Structures, Mechanical Engineering, Radio and Electronics or Hydraulics.

DESIGN and DEVELOPMENT ENGINEERS

STRUCTURAL DESIGN ENGINEERS AND STRESSMEN

with the minimum qualifications of H.N.C. are required and one Honours Graduate in engineering. Experience on aircraft or guided weapon structural design and stressing is preferable but not essential. The ability to design cheap and effective structures and specify structural tests is more important than mathematical ability. An Engineer with suitable experience is also needed to lead this section.

AEROELASTICITY

Two Technical Engineers are required for the Aeroelasticity Section, preferably with experience in the aircraft or Guided Weapon structures field. One should be an engineering graduate, one may be a mathematician.

AERODYNAMICS

Two Technical Engineers are required for the Aerodynamics Section, preferably with experience in supersonic aerodynamics. A degree in aeronautical engineering or its equivalent is essential.

WEIGHTS CONTROL

A Weight Control Engineer is required. The minimum qualifications are G.C.E. (A) in maths and the ability to read engineering drawings, or O.N.C., but previous experience of this type of work is desirable.

COMPUTERS

Computers are required to work with the technical staff on structural and aerodynamic problems.

Applications, outlining details of experience, qualifications and present salary, and quoting LDO/JF.11, should be addressed to:

THE PERSONNEL MANAGER

THE BRISTOL AEROPLANE COMPANY LIMITED

FILTON HOUSE, BRISTOL.

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GLOUCESTER

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FOR

AIRCRAFT DESIGN DRAUGHTSMEN
(SENIOR & JUNIOR)

Consideration will also be given to Draughtsmen with Mechanical, Structural or Electrical Experience.

Also

STRESSMEN
(SENIOR & INTERMEDIATE)

for both strength and flutter calculations.

The conditions of employment are good with progressive salary, good sports and welfare facilities, pension scheme, etc.

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Senior and Junior, required for (1) planning, programming and analysing control, stability and performance flight tests. (2) For planning, programming and analysing flight tests of turbine engines and other aircraft installations including armaments. Practical flight test experience essential.

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For maintenance and calibration of flight test instruments and development of new equipment.

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Must have good experience of aircraft instrument recording and applied photography.

These vacancies exist in an expanding Flight Development Section, at Chilbolton, Hants.

Applications stating full details of experience, qualifications, age and salary required, to the

PERSONNEL MANAGER
FOLLAND AIRCRAFT, LTD.
HAMBLE, HANTS.

The
GUIDED WEAPONS DEPARTMENT
of
VICKERS-ARMSTRONGS
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are about to form a new section to deal with problems of standardisation. This section will require a number of engineers capable of analysing and preparing technical data to be used as standard throughout the department. Investigation work will cover a very wide field of structural, mechanical and electronic design, engineering and testing.

There are immediate vacancies for

STRUCTURAL MECHANICAL
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ELECTRONIC ENGINEERS,

offering opportunity, scope and security in an interesting field of work.

Applicants should possess a sound engineering background coupled with the ability to think in a clear and concise manner.

Applications, quoting date and prefix letter of advertisement, to:

Employment Manager,
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Weybridge Works,
Weybridge, Surrey.

SITUATIONS VACANT

CIVIL AVIATION—NEW ZEALAND

Applications are invited from suitably qualified and well experienced persons to fill the following vacancies in New Zealand:

Vacancy 2210 Aeronautical Engineer (Structures), Wellington—(Reference No. 3/47/59)

Salary up to £1,110 (NZ) a year according to qualifications and experience. Qualifications desired: University degree in engineering or A.F.R.Ae.S. or equivalent, together with sound knowledge of the principle and practice of aircraft structural engineering, design and aerodynamics.

Vacancy 2244 Aircraft Surveyor, Airworthiness Division, Civil Aviation Administration, Auckland (1), Wellington (2)—(Reference No. 3/47/31)

Three positions vacant. Salary up to £1,045 (NZ) a year as merited. Qualifications desired: a practical engineer, preferably with maintenance and inspection experience of major transport aircraft. Applicants should hold major A.M.E. licences or equivalent and have held responsible technical positions with an aircraft constructor, airline, or aeronautical administrations, together with a thorough knowledge of British and American airworthiness standards and procedures.

Vacancy 2245 Aircraft Surveyor (Defects), Civil Aviation Administration, Wellington—(Reference No. 3/47/60)

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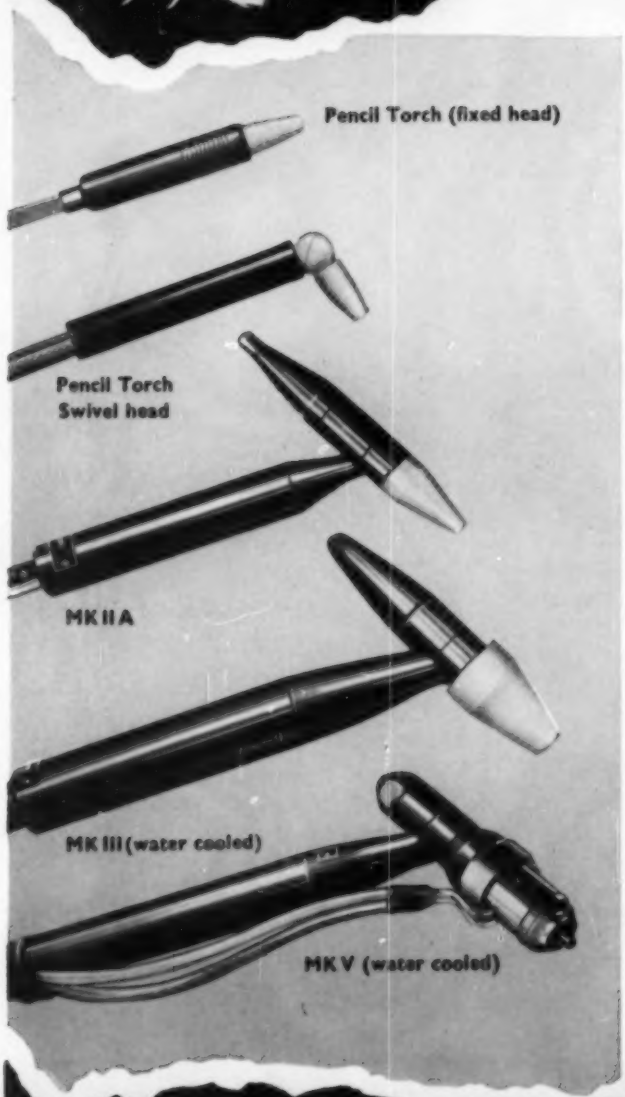

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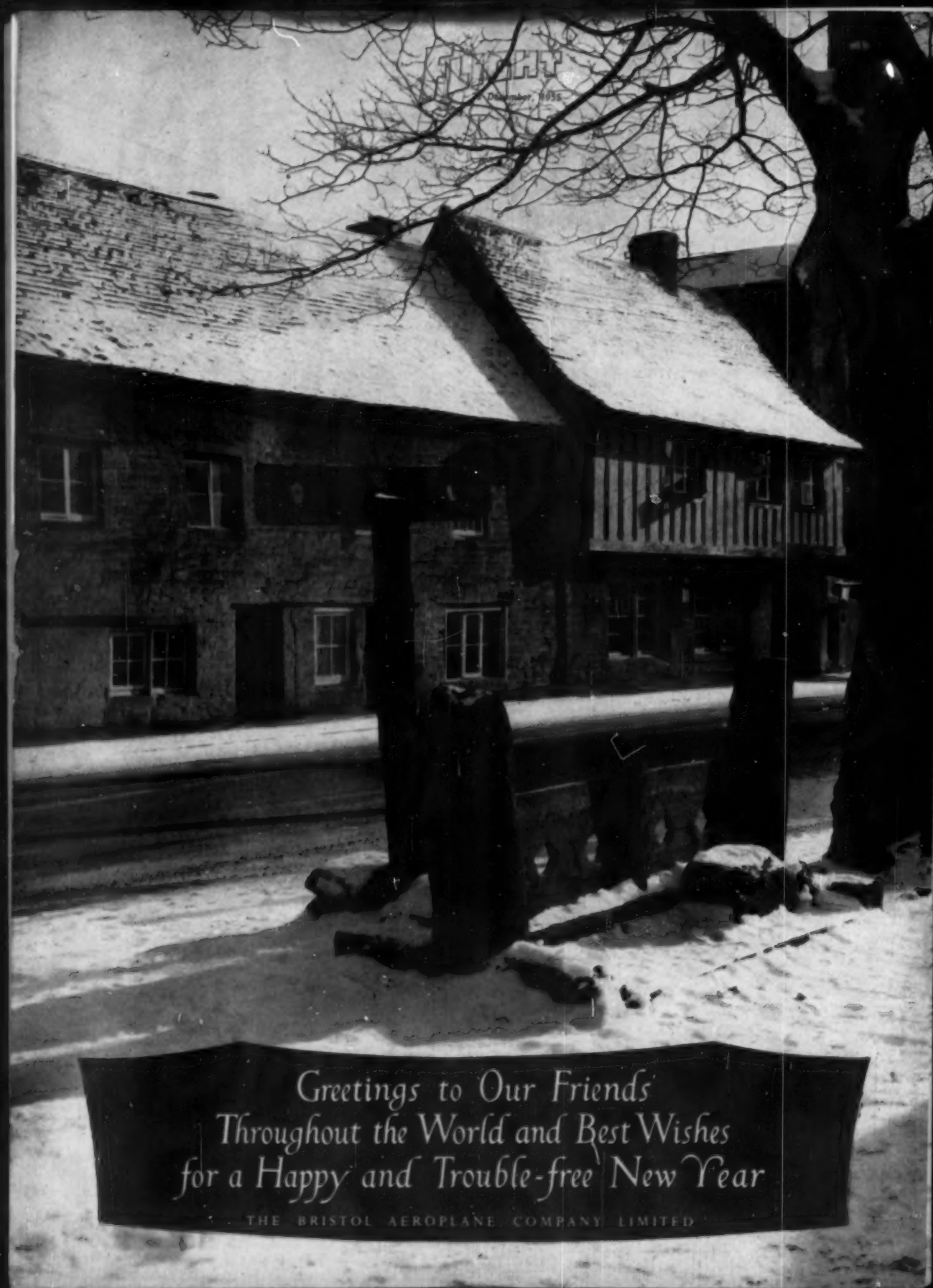
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